THE MICROSCOPE.

AN ILLUSTRATED MONTHLY DESIGNED TO POPULARIZE THE SUBJECT OF MICROSCOPY.

Edited by

CHAS, W. SMILEY, A. M.

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THE MICROSCOPE.

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NUMBER 13. NEW SERIES.

Objects Seen under the Microscope.

VII.—DISC OF OPHIOCOMA.

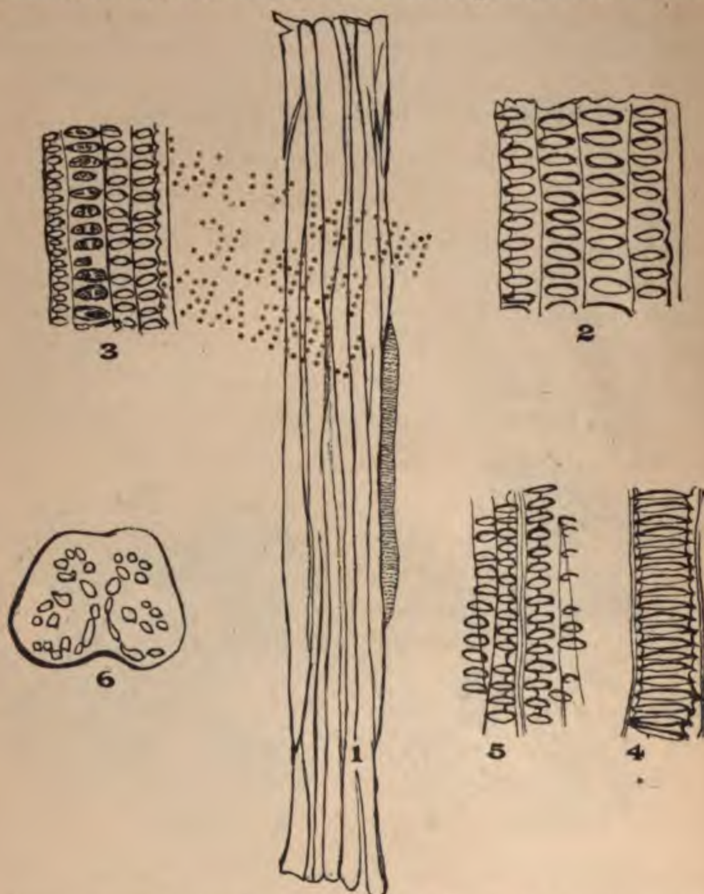
[PEN DRAWING.]

Ophiocoma is a star-fish of the variety often called brittle star or sand star. The discs are calcareous (limy) plates or skeletons, the spines of which make beautiful microscopic objects. Figure 1 is a view from above (dorsal) and Fig. 2 is a view from beneath (ventral), showing mouth aperture, teeth and their plates. These star-

1 2

fishes differ in size, some being as small as the dot on the letter i, and some measuring several inches with discs nearly an inch across. The "teeth" are to be seen in the center of Fig. 2 and look like the 5 sepals of a flower. These teeth like all teeth of Echini are pronounced as of the most wonderfully elaborate architecture to be found

in the Animal Kingdom. They show a gradual transition from the ordinary reticulated structure of the shell to the peculiar substance of which teeth in higher animals is made. The tooth is sometimes dissected out and mounted in balsam but it needs to be ground down some-



what to permit the light to pass through it. It is then seen that the base of the tooth is made of material like the shell and the upper or older part is made of bone, the intermediary part showing a gradual transition from shell to bone.

The disc of Ophiocoma can be bleached readily by immersion in caustic potash, but care must be taken not to go so far as to dissolve the integuments.

VIII.—SCALARIFORM DUCTS.

The stem of a fern is often of a deep brown color, very strong and hard. It owes these properties to a series of cells having very hard tissue called sclerenchyme. Within are series of bundles of Scalariform ducts (tracheides). They are so called from their presenting a regular ladder-like appearance (*scala*, a ladder). A thin section cut obliquely across the stem displays very well the beautiful structure of these ducts.

In the illustration (taken from the International Jour. Microscopy), Fig. 1 shows a bundle of Scalariform ducts taken from the British "bracken" (*Pteris aquilina*). It is enlarged 20 diameters. Fig. 2 shows a large duct enlarged 250 dia. and shows numerous elongated pores. Fig. 3 shows a duct with shorter pores. In Fig. 4 you can see the ladder well defined (250 dia). Fig. 5 is designed especially to show the thickness of the walls, and the projection of the so-called bars (250 dia). Fig. 6 is an end view of the bundle shown in Fig. 1. The ducts being cut across are seen to be firmly embedded in pleurenchymatous tissue.

Those wishing objects to use with their microscopes illustrative of Scalariform vessels, can send for Nos., 27, 28. 29 or 30 of White's objects. The four can be had for 30 cents in stamps.

The Typhus Bacillus.—Dr Fraenckel of Berlin, announces that he has discovered a typhus bacillus; and that by using it in vaccination, he has produced a rapid, benign course of the fever. Dr. Rumpf has cultivated an anti-fever bacillus which, he says, will cure typhus in eight days.

Microtome Knives and Their Care.

By BAUSCH & LOMB,

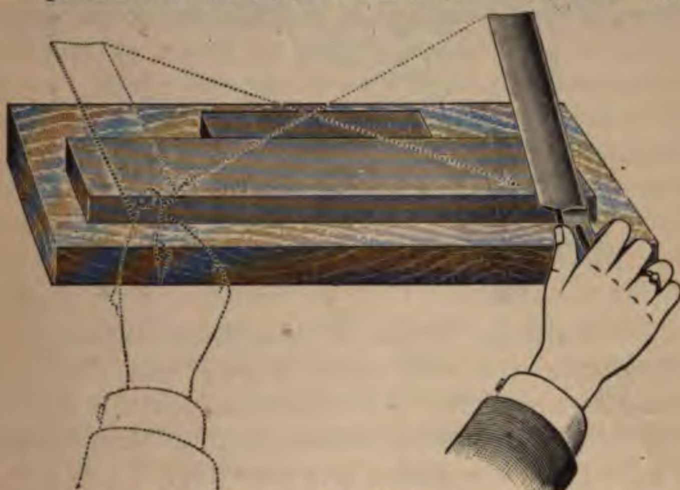
ROCHESTER, N.Y.

The requisites for good work in microtomy are, aside from the manipulative skill and the preparation of the specimen, a perfect working microtome and a good knife. The latter particularly, for, if the cutting edge is not in the best of condition, no good sections can be secured; we have had so many complaints from this source and for the reason that so few know the real *modus operandi* to obtain a keen cutting edge, that we present these instructions how to proceed to sharpen a knife and keep it in good condition.

We recommend to commence with, the yellow Belgian hone for the reason that it is the best obtainable; in using it, cover with palm oil soap and moisten freely with clean water so that a lather will be formed which must be kept during the entire time the knife is being sharpened. This soap has the advantage over the ordinary oils in use for honing in that the pores of the stone remain open, whereby quicker sharpening as well as a better edge and easier cleaning of the knife are the result. If a microtome knife is very dull or perhaps has small nicks in it, it is very essential to first sharpen it on a yellow stone and then draw it several times over a blue stone in order to obtain an exceedingly keen edge; with the blue stone is used a softer stone called "rubber" which is necessary, for, after the blue stone has been moistened with water, it is used to grind down the scum.

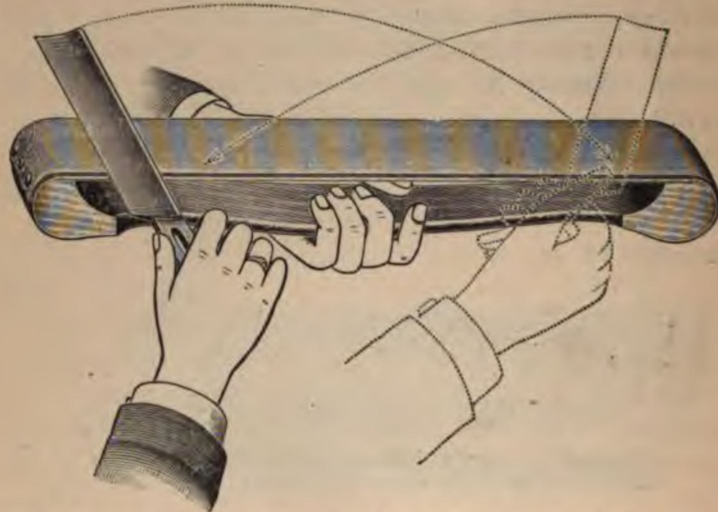
To begin with, the knife is sharpened on the concave side until a fine thread is formed on the cutting edge, which can easily be seen by drawing the knife across the finger nail; when this thread becomes visible along the entire cutting edge, the knife is passed without any pressure over the already prepared stone but in such a man-

ner that the entire edge is always toward the front as shown in Fig. 1. It is necessary that the mentioned thread be formed on the concave side only, in order that the amount ground off on the flat side be as little as possible. Should the ground surface on the lower flat side be too large, it will no longer be possible to obtain a perfect cut and the knife must be first of all reground on the flat surface. As soon as the thread appears, the knife is drawn equally to the right and left in the indicated directions, see Figure No. 1, without exerting the least pressure of the hand on the stone. After a uniform



keenness has been obtained by light and continued sharpening its quality can be judged by passing the edge of the knife lightly over the moistened tip of the thumb, and if the feeling that the knife will enter the skin be apparent, it shows that a sufficient keenness has been obtained on the stone and that its perfection can then be only attained by passing it over the strop. The knife is then carefully cleaned with an old linen cloth held between thumb and index finger, but in such a manner that this cloth does not touch the edge. After cleaning, it is lightly and carefully drawn across the strop with

the back of the knife towards the strop and without pressure of the hand, see Fig. No. 2. If the knife will now cut a hair freely along the entire edge it has attained the requisite keenness of a microtome knife, and after it has again been wiped off with a soft chamois skin it is



ready for cutting. It is to be suggested that the strop is slightly covered with oxide of iron, and rest on a flat and firm support. We recommend for this purpose a bow strop. Before each cutting of the preparations the knife should be passed over the strop.

Photographing Certain Natural Objects Without a Camera.

BY PROF. W. A. KELLERMAN, PH. D.
COLUMBUS, OHIO.

The objects referred to are those which are transparent or translucent, more particularly ordinary foliage leaves, and other botanical specimens, wings of certain insects, fins of fishes, etc. The process consists in using the object itself as the negative and printing from it in a photographer's printing frame, in the usual manner.

The majority of foliage leaves can be used, if it is desired to secure exact reproductions of their patterns of venation. Of many orders, such as Rosaceæ, Leguminosæ and Gramineæ, most of the leaves have veins sufficiently translucent to admit of their being used as negatives, without any preliminary preparation—even previous pressing and drying not being necessary.

But in case of many leaves of the orders Compositæ, Ericaceæ, Umbelliferæ, etc., they must be subjected to a process of bleaching in alcohol, followed by immersion in hot potassic hydrate; this is to be followed by thorough washing in pure and finally acidulated water, and pressing the leaves till dry between sheets of bibulous paper. Such prepared leaves will give pictures in which the veins and veinlets are dark and the remainder of the leaf light colored, just the reverse of the photographs obtained by using the fresh or dried leaves without further preparation. In either case the venation—even in minutiæ—will be well shown.

Sometimes young leaves, in other cases fully matured leaves, give the best results. Leaves from the herbarium can be used at will. If the veins or petiole are very much thicker than the remainder of the leaf, they can be shaved down. Other specimens may, in some cases, need trimming.

It is necessary that the object to be photographed be brought into *very close contact* with the sensitized paper, for, otherwise, all parts of the print will not be perfectly distinct. For this reason, the under side of the leaf—where, as a rule, the veins are more prominent—should be placed next to the clear glass in the printing frame, and the upper surface next to the sensitized paper. A layer of cotton or soft blotting paper can be placed over the back of the sensitized paper, which will insure closer contact with all parts of an object that may be somewhat uneven.

The time of exposure in bright sunlight will vary from a minute or two (for transparent wings), to fifteen or twenty minutes (for foliage leaves)—depending, of course, on the degree of transparency or translucency of the object. The print can be inspected from time to time and the proper density of the picture secured.

After exposure the prints can be fixed in a solution of hyposulphite of soda. Or if handsome photographs are desired, they can be toned in the gold solution commonly used by photographers, and fixed in the usual manner.

The process is so simple, so comparatively inexpensive, and the results obtainable so interesting that it is believed that the reward will be fully commensurate with the time and energy expended.

Moisture on the Cover Glass.—The cause of a deposit of moisture on the under side of the cover-glass must be sealing up before the object or the base on which it lies is thoroughly dry, or perhaps through the ring not being cemented properly on the glass slip, and so allowing the medium in which the finishing cement is dissolved to get through into the cavity in the cell in which the object lies, and condensing on the cover. The cure: With a sharp knife scrape off the ring of cement which lies on the surface of the cover-glass, also slightly down the side, about the thickness of the same; then warm the cover-glass slightly over a small spirit lamp, moving it about to prevent cracking it, and it should be then easily removable with the knife without injury either to the glass or object; then, before replacing, take care that the object is thoroughly dry. If the ring springs off instead of the cover-glass only, dry thoroughly; then put just sufficient cement on the underside of it to attach it to the glass, and let this dry thoroughly before finishing off.

Slides for Sale.—The Jersey Biological Station (England) will issue a quarterly publication and a series of 14 microscopical preparations of the rare and the less renown marine organisms. The text will describe the slides and give notes upon manipulation. The price is $5.25 for the year. Only 75 copies will be issued.

THE MICROSCOPE.

New Series, 1893.

For Naturalists, Physicians, and Druggists, and Designed to Popularize Microscopy.

Published monthly. Price $1.00 per annum. Subscriptions should end with the year. The old series, consisting of 12 volumes (1881–1892), ended with December, 1892. Sets of the old series cannot be furnished. All correspondence, exchanges, and books for notice should be addressed to the Microscopical Publishing Co., Washington, D. C., U. S. A.

CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

The Microscopical Soiree.—One of our English Exchanges remarks: "It is gratifying to learn that the loss on the last soiree was only £10; for the Coroydon Club soirees are always excellent." Our own observation is that in America a few too-zealous individuals get up these entertainments at considerable expense, expecting others to pay a large part of the bills and somebody or society to be $50-75 out-of-pocket. What is the return? Suffocating crowds of people who do not know whether an amœba is an animal or a plant nor which end of the tube the object glass goes in, crowd around and ask "What is it?" say "oh! my, aint it lovely," and return home with no more knowledge than they carried there. Not once in a hundred does some one develope love enough for science to go and buy a microscope.

We are, therefore, in disfavor with the idea. We do not see why all this expense should be incurred. We have been told that there are microscopists so vain that they enjoy exhibiting themselves at these soirees and think that it pays. We do not like to believe it and at all events think the game is not worth the candle.

But what shall we do to create a public interest? In lieu of the soiree, hold a dozen meetings during the year to which members may bring friends selected for their appreciation of science, and young people who in school have shown some desire for

such knowledge as microscopy can impart. Let half of these meetings be exhibition evenings but let the explanations of what is to be seen. and how to utilize the facts be the prominent feature. Let the other half of the meetings be working sessions at which the visitors may see the processes of cutting, staining, mounting, etc., actually carried on and explained. Many a bright youth may have his thoughts bent in the right direction by this means, and the beauty of it is that the cost is zero and the plan productive of new members. The evil if any is that our conceited members cannot parade themselves before the dear public in the way that they are said to do at the soirees.

QUESTIONS ANSWERED.

NOTE.—*Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of all grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.*

181.—*What is a Catoptric Ocular?—S.*

This term probably means a reflecting microscope, or an instrument used for examining objects by reflected light.

182.—*Can you give me directions for Koch's "petrifying" method for sections of jaws and teeth?—J. D. Moody.*

Saw off a thin slice of the jaw and tooth, stain it, dehydrate in absolute alcohol, and imbed in a thickened chloroform solution of copal, on a glass slip. Evaporate the chloroform, then grind down the section on coarse and fine stones until it is thin enough, wash and mount in balsam.

183.—*What is Walmsley's arrangement whereby enlargements of objects can be made by anybody as mentioned in Stowell's Microscopical Diagnosis?—T. K. Butler.*

It is a small, dry-plate camera attachment which can be placed on the microscope tube and the object is then photographed.

184.—*I wish to begin the study of textile fibres. Where may I get information on the subject?—C. E. H.*

The literature is scattered through the Microscopical and Textile Journals. See A. M. M. J., Vol., VI, pages 22, and 47, for good descriptions of fibres.

185.—*How shall I stain muscle to show the Trichina well and how shall I mount it?—E. P.*

Any carmine stain will color muscle deeply and the Trichina lightly or not at all. The fresh material should be hardened in alcohol or otherwise, like any other pathological material; the sections cut, stained and mounted in balsam. Trichinous muscle shows well when mounted in Farrants' solution or in glycerine. Unstained, teased, trichinous muscle mounted in glycerine, makes a typical mount. Use well hardened material or the glycerine will macerate the trichinæ in time.

186.—*How shall I treat specimens of ham or pork to preserve them so sections can be cut by freezing, paraffin or celloidin process?—E. P.*

Soak the material in water to extract the salt, then harden in several grades of alcohol up to 95 per cent, and preserve in the latter grade until cut.

187.—*I have read that nerve tissue for microscopic study should not be placed in zinc chloride or in alcohol.—Why?—Medicine.*

Probably a mistaken notion that zinc chloride would injuriously affect the *corpora amylacea* sometimes observed in brain and cord specimens. These *corpora amylacea* are quite different from the real starch bodies found in vegetable tissue. Zinc chloride would not often be used on nerve tissue, but alcohol is indispensable. The so called *corpora amylacea* seems to be present in normal as well as pathological specimens and are probably of no importance.

PRACTICAL SUGGESTIONS.

By L. A. WILLSON,
CLEVELAND, OHIO.

Section Cutting.—It is almost trite to remark that first rate sections can be cut with a razor. While first class microtomes are a great luxury, a good sharp razor will answer all the purposes of study and investigation. Nearly all the great and important discoveries in tissues were made before the advent of microtomes. In cutting with a razor the amateur will do well to be content with very small sections. A very small piece of homogeneous tissue will exhibit all that a large section can.

Lichens.—These plants must be studied from sections. The sections cut with a razor can be made quickly, conveniently and satisfactorily. Shave a very small piece from the edge of any part of the thallus; place the section on a slide in any convenient fluid, put on a thin cover and view with a power equal to a quarter inch objective. To see the fructification complete, cut an apothecium in half and then shave a thin section along the cut surface, being careful to include the top portion. In this manner one will be able to see the hymenium with the asci and spores, the green conidia, the cortex and often the spermogones. Few specimens are more interesting and beautiful or will exhibit so many points at once. The specimens are easily obtainable and will well repay the student.

Puccinia.—Having a lot of leaves with many black, hard circular, raised spots scattered over them, I tried many ways of examining them but obtained no satisfaction. As a last resort, I had recourse to my razor, as above described. I cut the leaf through one of the black spots or sori and then made a very small thin section of the edge of one of the black spots. Placing this on the slide with a drop of potasium hydrate, covering with a thin circle and viewing with a one-fourth objective, a beautiful sight was unfolded.

Hundreds of obtusely accuminate pedicillate spores were disclosed with their arrangements upon the leaf. On mounting in balsam the spores assumed a golden yellow hue and formed a sight to gladden the eye of the microscopist. It proved to be *Puccinia malvacearum.*

Sclerenchyma.—This cell formation composes the hard tissues of nuts and of stone fruits. Excellent specimens may be obtained by cutting as above described.

The section should be taken from one of the halves of the nut, after removing with a knife, the smooth surface where the two halves join.

Cut a thin shaving about the size of a pin head and place upon a slide in any convenient liquid. The above parts are so hard that they will invariably nick the razor so that no razor of any value should be used in the experiment.

Dr. Moore's Method of Staining Blood.—The following is copied from Vol. III, page 136 of the American Microscop-

ical Journal and is a quick and efficient way of staining blood, and of double-staining nucleated blood.

The blood is evenly spread in a thin film on the slide, and dried in the usual manner. It is then covered with a solution containing eosin 5 grs, water 4 drachms, alcohol 4 drachms. In about three minutes this is washed off in a glass of water; and, without drying, a solution containing methyl green 5 grs., and one oz. of water is flowed over the slide. In about two minutes the slide is washed, dried and the corpuscle preserved in Canada balsam.

SCIENCE-GOSSIP.

Amœba.—This organism has been sectioned and stained in such various ways as to exhibit the organism of its minute structure far better than ever before understood. Amœba was believed to be very near to simple protoplasm, now it is found to contain an excretory system. One man has seen striations by means of which contraction takes place. Further research is going on in the Huxley Laboratory at South Kensington, London.

Scientific Work in Illinois.—Dr. Josua Lindahl has been dismissed from the post of State Geologist by political influence and an obscure collector of fossils put in his place. The late Prof. Worthen, while state geologist collected 2871 fine specimens which the state has purchased from his estate. In England, the making of private collections by a public official would be considered very improper and in our own country, the Smithsonian Institution emphatically prohibits every employee, even its messenger boys, from making private collections.

Mechanical Finger.—Occasionally one wishes to pick up a diatom or other small object in mounting, and the mechanical finger is about the only thing with which it can be done successfully. A slip of wood is held in place on the side of the tube by rubber bands. The end of this slip is split, and in the split is placed a cat's whisker. This is so pointed and stiff that it makes a good implement for the purpose. Arrange the whisker so that the point of it is in focus, and then spread your material on a slip. Pick out a diatom, and after moistening

the point of the whisker slightly, rack it down, and the diatom will adhere to it. Raise it up, and place the slip on which it is to be mounted on the stage. The surface of this must, of course, be prepared with a gum solution, such as is described in the text-books, and as the diatom touches it, it will leave the whisker and adhere to the slip. This is not offered as a substitute for the mechanical finger entirely, but it is a simple appliance that is easily made, and will be found useful many times by those who are not fortunate enough to possess something better for the purpose.—*Work.*

Stone Under the Microscope.—It is often held that the best method of determining the probable durability of a building stone is to study its surface, or thin transparent slices, under a microscope. This method of study in recent years has been most fruitful in developing interesting and valuable knowledge of a scientific and truly practical character. An examination of a section by means of the microscope will show not merely the various substances which compose it, but also the method according to which they are arranged, and by which they are attached to one another. For example, pyrites is considered to be the enemy of the quarryman and constructor, since it decomposes with ease and stains and discolors the rock. Pyrites in sharp, well-defined crystals sometimes decomposes with great difficulty. If a crystal or grain of pyrites is embedded in soft, porous, light-colored sandstones, its presence will certainly demonstrate itself by the black spot which will form about it in the porous stone, and will permanently disfigure and mar its beauty. If the same grain of pyrites is situated in or near very hard, compact, non-absorbent stone, the constituent minerals of which are not rifted or cracked, this grain of pyrites may decompose and the products be washed away, leaving the stone untarnished.

Higher Medical Education.—Rush Medical College will hereafter require four years attendance at college from students who begin the study of medicine. To encourage proper preliminary study, graduates in arts and sciences from most colleges, and graduates in pharmacy and dentistry from approved colleges will be graduated after an attendance on three courses of lectures.

The Newberry Fund.—Scientific work in geology, palæontology, botany and zoology is to be aided by the income from the $25,000 memorial fund to be raised to the memory of Dr. J. S. Newberry.

Bacteria Deprived of Sunlight.—The nitrifying bacilli of the soil are entirely removed from sunlight and seem to thrive on mineral food. How do they obtain energy with which to manufacture protoplasm from inorganic material? Doubtless from the gases or liquids within their reach. Prof. Johnstone Stoney, thinks (Sci. Proc. Roy., Dublin Soc., VIII, 154), that the energy may be imparted by the impact of the more swiftly moving molecules of these gasses and liquids. If that be the case, the excessive minuteness of the bacilli is explained.

CORRESPONDENCE.

White's Objects.—I would strongly urge those of your readers who desire beautiful, interesting and instructive objects for the microscope to send to Mr. C. W. Smiley for a few samples of White's botanical sections. They are well cut and stained and temporarily mounted, and can be examined in that way, but to see them at their best they must be mounted in glycerine or balsam. I have about twenty slides mounted in benzole balsam, and take great interest in them; that interest has increased since I have examined them by polarized light, and when a selenite plate is put under the object slide, they are beautiful beyond description, and must be seen to be appreciated. When the prisms in the polarizer are turned to show a dark ground illumination some of these sections show a differentiation of parts that are fine and clear. They stand out, as it were, with a solid, or stereoscopic appearance. So beautiful are they that I have placed them in the case where I keep my "Oh, my" slides.

I have not yet had time to make negatives of the beautiful objects mentioned above, but when I do, which will be soon, I will send several prints to be engraved. I have ordered from Carbutt a yellow ray filter, which used in connection with his orthochromatic plates, will give value to the staining.—Thos. J. Bray, Warren, Ohio.

THE MICROSCOPE.

Contents for January, 1894.

TO THOSE WHO HAVE REMITTED FOR 1894.

We feel especially and unusually thankful to those who have sent in their checks during the past five weeks.

Like others, we are struggling with the "hard times" and your promptness helps materially. We cannot write personally to thank each one, but we take this means of telling you how sincerely we appreciate your thoughtfulness. In spite of the times, which we believe will change before mid-summer, we shall be able to increase the number of our illustrations during the year.

THE MICROSCOPE.

FEBRUARY, 1894.

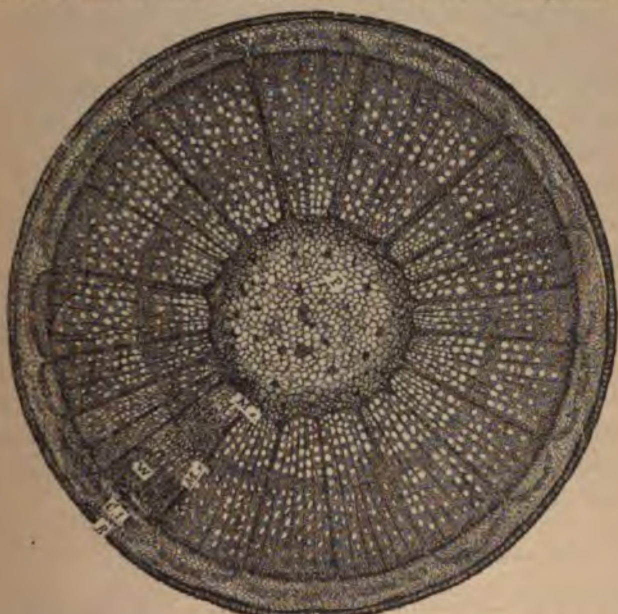
NUMBER 14. NEW SERIES.

Objects Seen under the Microscope.

IX.—SECTION OF STEM OF BEACH.

[PEN DRAWING.]

We have a lot of slides of wood sections which are being sent out as premiums and the illustrations herewith presented show their appearance under a magnification



of about 40 diameters. The descriptions which follow are intended to make plain to every body the meaning of what is seen in the slides.

The stem of a plant when seen under the microscope generally consists of three parts—pith, wood, and bark. The pith is in the center (P), the bark outside (B), and the wood (W), between the pith and the bark. This wood is separated into segments in the exogenous plants, so-called because growing from the outside, by medullary rays (M. r.) resembling the spokes of a wheel. They are composed of unchanged cellular tissue that extends from the pith to the bark. The pith (P), is composed of cellular tissue, and the cells are generally hexagonal in shape when seen transversly as in the cut. Sometimes they present a ragged appearance from being torn by the rapid growth of the plant and in the Monocotyledons the cellular mass in which are the fibro-vascular bundles corresponds to the pith and medullary rays together. Sometimes in the case of hollow stems the cells composing the pith have cracked and dried away or are attached to the sides in ragged patches. Immediately surrounding the pith is the medullary sheath (M. s.) composed of a delicate membrane, usually spiral in structure; this forms the limit of the woody portion of the stem. The woody portion extends from the medullary sheath to the cambium layer (C.l.). The latter is situated between the wood and the bark. The cambium is made up of a single ring of delicate cells which changes into cellular and vascular tissue thus forming new lateral cells and occasionally a new radial cell. When continued, these form a new ring of wood and also a new layer of bark. At the same time they piece out and extend the medullary rays as fast as the stem expands.

X.—SECTION OF STEM OF IRONWOOD.

The pith (P), medullary sheath (M. s.), medullary rays (M. r.), Wood (W), Cambium layer (C. l.) and bark (B) are all seen in the Ironwood as they were in the beach, but with marked differences. The pith is now less con-

spicuous, the medullary rays are much finer and greater in number consisting of more lines, the wood instead of being in two rings, is in nine rings, the cambium layer is narrower and the bark is much the same.

The bark is in three layers, the external (epiphlœum) which includes the corky layer, the middle or cellular envelope, and the liber. Next to the liber is the cambium layer which always separates it from the wood and it is in this that growth takes place. The epiphlœum

usually consists of two or more cubical or tabular layers and it is this which usually forms cork. Cork is by no means confined to one tree but exists in greater or less abundance in the bark of all exogenous stems. The middle layer is composed of cells and is more open than the preceeding layer and often forms canals which have the character of lactiferous vessels. This layer often forms the greater part of the bark. The liber consists of cellular vessels usually equaling in number the cells of the

wood, the one nearest the wood being the last formed. It also contains woody fibre and lactiferous vessels.

In the beech, where the bark is smooth, the growth takes place in the liber layers chiefly, the cellular envelope and cork merely expands to make room for the enlargement of the stem. The cork is composed of flat tabular cells, not of coarse cork tissue.

XI.—SECTION OF STEM OF SYCAMORE.

Here again can be seen the six parts of a stem as

pointed out above but with variations peculiar to this tree. The four rings of woody fibre are now very prominent, and the medullary rays to the number of over 50 stand out with great prominence.

The woody structure of plants is composed of woody fibres and ducts except in the Coniferæ where the latter are wanting. The woody structure of a stem of more than a year's growth has the appearance of being divided into concentric rings and each of these rings is supposed

to represent a year's growth, but some think that these rings represent only a period of growth and that a new ring is added each time a new set of leaves is formed. If in a season the tree's growth be stopped by drought and in the fall a new set of leaves be formed the stem would have two rings the width of both together being a little less than that usually produced in a single year. The width of the rings is usually greater near the pith and decreases towards the bark. Their composition (cellular and vascular tissue) is uniformly the same whatever their thickness but the arrangement varies. Sometimes the vessels predominate as in the Beech and Sycamore and sometimes the cellular tissue as in the Ironwood. Sometimes the vessels are uniformly distributed throughout the entire ring and sometimes they predominate toward the center. Sometimes they are distributed with regularity throughout the ring but the most general manner of distribution is that in which most of the vessels are near the inner surface of the ring which is the first part formed. The more vessels there are, the softer is the wood—Sycamore is softer than the two preceding woods. Ironwood is harder than the other two because it has the least number of vessels.

SPONGES.

By M. PFLAUM,
PITTSBURG, PA.

[Read before Iron City Microscopical Society, January 9th, 1894.]

What is a sponge? Perhaps most of us might be pardoned for defining it to be that soft porous toilet article so useful and convenient for many purposes. We see it and handle it every day, and the familiarity which in this case certainly breeds indifference, deprives us of a delight which the slightest study of the subject would give us.

In our collection of slides we have of course spicules of sponges, and this seems generally to satisfy us. It cannot be said that a sponge in its natural condition is an object of beauty or should in any way attract an amateur microscopist. We should therefore be thankful to those patient investigators who extract, by perseverant labors, interesting knowledge from nature, as bees gather honey from flowers. To taste these sweets I have consulted Kent, Carpenter and the Cyclop. Brit.

Classification.—The exact classification of sponges has not yet been definitely agreed upon. Prof. Haeckel insists to place them with the Cœlenterata, and as a close relative of the Corals, mainly because he claims for them an ectoderm and endoderm and a true process of sexual generation by germ cells becoming fertilized by sperm cells, which latter claim is affirmed by Carpenter. Kent, however, very forcibly denies both of these claims, finds neither ectoderm nor endoderm, nor any indication of sexual generation; and therefore allies sponges with the Choano-Flagellates or funnel-shaped flagellate infusorias as classified by him. Sponges are generally divided into four classes according to the nature of their skeletons or spicules. 1. Calcareous sponges having spicules of carbonate of lime. 2. Silicious sponges, which exist in the greatest number, having silicious spicules. 3. Keratose or horny sponges, being the sponges of commerce. 4. Gelatinous sponges in which all spicules are absent. All sponges, however, no matter what their skeleton, are composed of a soft slimy sarcode forming the body, covering the exterior as well as the base of the interior canals, ducts and cavities and forming a connective tissue, showing, however, no fibres.

Structure.—All sponges from the most simple to the most complex have the same special characteristics to a greater extent perhaps than any other class of beings. Just as each species can be clearly defined from the

other so all have well-defined qualities which unmistakably mark them as a separate branch of creation. These characteristics may be stated as follows: 1, on the exterior of the body are many, more or less minute, openings—pores for admitting water into the interior, and one or more larger openings—osculæ—for emitting water from the interior without any other exterior organs; 2, the animalcule or colony of animalcules is concealed in the interior without any contact with the exterior; 3, the animalcule has a collar and flagellum.

Pores.—These exist in innumerable quantities, and can generally be contracted. What causes the influx of water has not been sufficiently ascertained. Some species have been observed with ciliary motion at the pores, but this has not been proved sufficiently. It may be possible that the natural pressure of the water surrounding the sponge may cause it, without any artificial effort to enter the body no matter how small or narrow the pores. No matter how, the fact is water does enter, and this fact upon the slightest consideration becomes one of great interest and another proof of nature's marvelous adaptability of means to ends. Of course the use of the water is clearly apparent and is the same as for all infusorian food. However, *how* this water is used is an interesting question. It passes through the internal canal system, the food particles it contains are taken up and the remainder, together with the fœcal matter, is sent into larger canals out through the external larger orifices called, wrongly, osculæ. As these osculæ might with their polluted contents taint the inflowing water, they are arranged according to the growth of the sponge: where upward these osculæ stand elevated above the pores; where downward, as hanging on rocks, even with pores, as in such case the matter sent out naturally will leave the sponge.

In a live active sponge the inflow through the minute

pores can hardly be noticed except by using colored particles which have been observed to enter the sponge. In one case indigo being used gave the whole sponge a bluish tint. But the outflow has been likened by observers to a continual fountain. A little sponge placed in a saucer of water sent out a stream twelve feet long. This was in open air, offering comparatively no resistance. It must be apparent that an enormous force must be required to send out a stream against the necessary resistance and pressure of the surrounding water. Again, is this inflow and outflow continuous, especially the inflow, which may be caused by external pressure alone? Observations have shown the negative. It was found that the opening of both the pores and osculae are within the control of the sponge and can be opened and closed at its pleasure. Here the wonder increases: how, without any apparent force—controlling organ—power is exerted. The seat of power in sponges is supposed to be in the amœboid bodies, mentioned hereafter. But even were this confirmed, it would be open to further investigation how these bodies can exercise force upon another part of the sponge separated from, and without any noticeable connection with them.

CANALS.—If there are two currents of water, there must necessarily be two different water ways, each serving its own purpose. The incoming currents are of course small, their contents after being utilized enter a larger opening acting as a cloaca, and thereby leaving the body. The simplest form (*Ascetta primordialis*) has but one osculum, being the mouth of a large central cavity, into which the smaller influent canals enter. In the higher orders the canal system is very diverse, intricate and numerous. The water entering the pores does not in all cases pass through simple ducts before reaching what may be called digesting chambers, but in the simpler forms enters at once into what Kent calls ampul-

laceous sacs; Carpenter, flagellate chambers; in which the sponge animalcule "lives, moves and has its being." These chambers according to Kent are the main characteristics and chief points in the classification of sponges. In shape these chambers differ in each species, some are circular, others oval or semi-circular or pointed at each end. These chambers are lined with the mucillaginous sarcode—cytoblastema, having imbedded in them, facing the center of the chamber, the sponge animalcule. In shape they are round or oval cells, as a body, having upon each a funnel-shaped hyaline collar of nearly the length and breadth of the cell, with a flagellum extending from the cell through and out of the collar. The discovery of this zooid was made comparatively recently, 1866, by a Pennsylvanian, Prof. H. James-Clark. These zooids, like all infusorias, show the presence of a nucleus and two contractile vesicles at the posterior end. Their functions seem to be of a respiratory nature, but chiefly to gather food. The flagellum, by rapid motion creates a current, which striking the outside of the collar, which also has a motion of a nature which caused Kent to call it circulatory or cyclosis, makes all food particles adhere thereto, from which they are drawn up over the rim and thence along the inner surface into the body of the animalcule. Before proceeding farther it should be remarked that each of these flagellate zooids is a separate being without any bond or connection with its neighbor, except being all attached to the same connective tissue, the sarcode, or cytoblastema. The process of feeding just related has been beautifully demonstrated by Kent, by mixing the food water with carmine. It is claimed that each zooid exudes excremental matter through its food channel, but this like many other facts remains yet to be verified. In this category of "claims" also belongs the location of the mouth at the root of the flagellum.

These zooids are amœboid in their nature. Both the collar and flagellum can be inverted and be received within the body of the animalcule. It can also send forth processes, pseudopods, with or without the indrawing of the collar and flagellum.

INTERNAL STRUCTURE.—In Keratose—horny—sponges the skeleton is familiar to all. The substance is named "spongin." How Gelatinous sponges are held together, may be inferred from what we observe in jelly fishes. Calcareous and Silicious sponges, having possibly a more fluid sarcode, are provided with spicules generally so placed as to serve as a skeleton. These spicules are as beautiful in form as multitudinous in variety. In some species the spicules coalesce and cause thereby objects of wondrous beauty as Venus flower basket (*Euplectella*). In others spicules are attached to the outside for defensive purposes.

In addition to spicules, and generally lying close to them, sponges contain granular bodied irregular masses, which have been recognized as amœboid cells, and named cytoblasts. Neither spicules nor cytoblasts come in contact with the flagellate chamber. The exact functions of these amoeboid bodies are as yet in doubt. As before stated, it is believed that they exert whatever force a sponge exercises. But it is further surmised that they also take hold and remove all foreign substances which have entered the sponge. In higher organisms other cells and minute structures have been observed, the uses of which have been differently interpreted.

LIFE HISTORY.—Of this little is known, much surmised. Prof. W. J. Sollas of the University of Dublin, the author of the article on sponges in the Encyc. Brit. quotes authorities for the occurrence of both sexual elements in the same individual, but in uneven quantities; the male predominating in one, the female in others. One authority given by him found one male to 100 female forms.

In some sponges the sexes are claimed to be distinct. Both sperm as well as germ cells are claimed to develope from wandering amœboid cells which first exhibit lively amœboid movements, but later on pass into a resting stage. This, as already indicated, is strongly advocated by Prof. Haeckel. Kent, however differs radically from this view, and knows only the following process : One or more sponge zooids, having lived its or their allotted span, become quiescent, take on an amœba form, become a cell in which spores are generated, which, when sufficiently advanced, pass out through the osculae. The cell looses its shape, and what are called "swarm-gemmules" appear. These, when sufficiently developed, show on their upper part flagellated collared cells with undeveloped cells beneath. Ultimately they settle on some firm substance and begin sponge life like their parent.

In the case of commercial sponges, artificial propagation of sponges, by cutting from live specimen, has been successfully attempted under the auspices of the Italian government. Pieces about an inch square were cut containing part of the exterior of the subject. These were tied to sticks and submerged in the proper locality. This process proved a success, but had to be abandoned by reason of serious objections from fisherman.

Slides for Sale.—The Jersey Biological Station (England) will issue a quarterly publication and a series of 14 microscopical preparations of the rare and the less renown marine organisms. The text will describe the slides and give notes upon manipulation. The price is $5.25 for the year. Only 75 copies will be issued.

To Write on Glass.—Make an ink by dissolving in a warm water bath; bleached shellac, 10 parts; venetian turpentine, 5 parts; oil of turpentine, 5 parts. When dissolved, add 5 parts of lampblack. Use with a pen the same as other inks.

THE MICROSCOPE.

New Series, 1893.

For Naturalists, Physicians, and Druggists, and Designed to Popularize Microscopy.

Published monthly. Price $1.00 per annum. Subscriptions should end with the year. The old series, consisting of 12 volumes (1881–1892), ended with December, 1892. Sets of the old series cannot be furnished. All correspondence, exchanges, and books for notice should be addressed to the Microscopical Publishing Co., Washington, D. C., U. S. A.

CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

A Geological Survey could be made of practical benefit in business operations by giving advice upon the location of mines, the sinking of wells, and selections of sites for cemeteries, forts and heavy buildings, the obtaining of material for building roads, the nature of soil and subsoils with reference to drainage, etc.; but we are sorry to think that government surveys usually pay little attention to such things, but busy themselves with hunting fossils, in studying names and synonyms, in trying to ascertain the order of deposits in geological time and to find out how old the earth is; not to mention the junketing trips, the nepotism and favoritism, the expense, extravagance and concealed or obscure methods of inducing legislators to make appropriations and to suppress investigations. Would it not be better to depend upon the popular appreciation of practical results? Experience of capable men has shown that it would not be practicable to do so, and hence the prevailing methods.

Snails Live Indefinitely.—Only the other day a specimen from an island off the coast of lower California, inclosed in a drawer with part of the molluscan collection, was found to be alive. It had had no food or water for more than six years. When placed in a box with moist earth it protruded its foot and began to move about, and seemed to be as well as ever. Some time ago a few snails of a different species, gathered in

Mexico, reached the Smithsonian Institution and were placed in a box. They remained undisturbed for two years and three months, at the end of which time they were put into a jar of glass with some chickweed and a small quantity of tepid water. Pretty soon they waked up and appeared quite active.

QUESTIONS ANSWERED.

NOTE.—*Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of all grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.*

188. *What is the best way to reduce, clean and mount the Radiolaria from Manitoba?—C. S.*

Boil a piece of this shale with a crystal of sal-soda of equal bulk and a small quantity of water in a wide test-tube. When the shale begins to break down, flood it with hot water and pour it into another test-tube to deposit. Repeat the above boiling with soda and water on the remaining hard fragments of shale until enough disintegrated material has been obtained. The time of contact with the sal-soda should be as brief as possible, because the siliceous radiolaria will be corroded by any long contact with caustic alkalies. Collect the sediment into one tube, flood with clean water, allow the sediment to fall, pour away the water, add more, and so on, until the sediment is well washed and free from soda. Remove the water as nearly as possible, add about a half dram of strong nitric acid, boil, drop in a small crystal of potassium bichromate, boil thoroughly, add water and wash as above, until the acid is removed. Examine a drop of the sediment. If the forms are not clean, repeat the boiling with acid and bichromate and wash again as above. There is much fine sand and spicules present which may be removed to a certain degree, by shaking the sediment in a test-tube full of water and pouring away as soon as the heavier radiolaria have settled, and while the finer particles are still floating. This repeated several times, will clear the deposit enough to allow a fairly clean mount to be made. Place a drop of the sediment in the center of a concaved slip, or varnish ring cell, dry, add a drop of balsam, boil it gently over a lamp, apply a cover, and harden *without pressure.*

The forms are not numerous and are best picked out singly with a mechanical finger, if a really clean mount is desired.

PRACTICAL SUGGESTIONS.

By L. A. WILLSON,

CLEVELAND, OHIO.

Photomicrography.—The microscope is placed in a horizontal position. The mirror is then vertical, and the tube with the eye-piece is inserted into the camera. Where the tube enters the camera a black cloth is carefully wrapped to exclude all light. Light from an acme lamp is directed upon the concave mirror and reflected from behind upon the object through the tube. A small piece of camphor is placed in the oil of the lamp. In this way, *Arachnodiscus* has been beautifully taken with a Spencer one-sixth immersion objective. With an inch objective, I photographed a Calyptra of a Moss and the Pollinia of Milk Weed and an Ovipositor of a Fly with such definition of every minute detail, that no retouching of the picture was necessary. With the one-sixth and exposure of fifteen minutes and with the inch, ten minutes was all that was required.

Examining Writing.—Great issues often depend upon the determination as to which of two signatures to a document were first written. The solution of this problem is more difficult than would at first be suspected. The appearance of the lines to a non-expert is frequently the opposite to the truth. Experience and intelligence are requisite to the interpretation of the picture unfolded by the microscope. Delicate focussing and observing which line first comes into view is one test. Try this test by both transmitted and reflected light. Another test is the "web." The web is formed by the ink of the last writing, running into the first. This is a very interesting subject to experiment upon. Try it with crossed thick lines and crossed thin lines, thin lines across thick lines and thick lines across thin lines, with the same and with different inks, with slow strokes and quick strokes, and one will be surprised at the intricacy of the problem.

Photography is a good adjunct to the microscope on matters of this kind. First take a negative, from that make a positive then photograph the positive where the lines cross. In the print

resulting from the last negative it may readily be seen which line is on top.

Fats.—Nearly all fats are beautifully crystalline. To study the crystals of different fats, I prefer a quarter inch objective. Place a very small portion of the fat on a slide and press out into a thin film with the thin cover. Dr. Thomas Taylor's method of examining butter with the polarizer is interesting. Boil the butter a few minutes set away in a pill box or other receptacle to cool. Fill a shallow cell with sweet oil. Put in a small portion of the boiled and crystalized product, gently scatter the granular crystals through the oil, place on thin cover, and view with polarized light. Do not treat them roughly while scattering as you would break up the crystals. I have treated lard in the same way and produced crystals of the same rotund form as butter crystals, but which exhibited a different cross from the pure butter crystals.

Stomata.—These organs of a leaf may be easily examined by scraping a small portion of the cuticle, spreading it upon a slide in a drop of any convenient fluid, covering and examining. They may be seen with a low power but will appear best under a quarter objective.

SCIENCE-GOSSIP.

Sectioning.—If you have never tried the "Bayberry Tallow" method of sectioning loose tissues like lung and pancreas, you have never succeeded in getting the most perfect mounts.

Look Sharp.—"From a single and hasty view of bodies under the microscope we are liable to form erroneous ideas of form."

RECENT PUBLICATIONS.

Funny Bone. A Book of Mirth for Doctors, Druggists, Dentists, Medical Students and Others. St. Louis, Mo., 1894. Price 50 cents.

This is a book of caricatures and jokes which have been compiled from the medical journals, etc. Some of them are very good. Over 150 of the illustrations are said to be original. Whoever enjoys such things can afford to send 50 cents to the Publishers, 1421 Market Street, St. Louis, Mo.

THE MICROSCOPE.

Contents for February, 1894.

THE MICROSCOPICAL JOURNAL.

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THE MICROSCOPE.

MARCH, 1894.

NUMBER 15. NEW SERIES.

Objects Seen Under the Microscope.

IX.—VARIOUS FORMS OF BACTERIA SUPPOSED TO CAUSE DISEASE.

LIST OF ILLUSTRATIONS.

1. Consumption. *Bacillus tuberculosis.* Diameter 1-100,000 inch.
2. Diphtheria. *Bacillus klebs-loffler.* Dia. 1-40,000 inch.
3. Pneumonia. *Micrococcus pneumonia.* Dia. 1-35,000 inch.

4. Leprosy. *Lepra bacillus.* Dia. 1-100,000 inch.
5. Pyæmia. Micrococcus from pus.
6. Typhoid fever. *Bacillus eberth-gaffky.* Dia. 1-40,000 inch.
7. Scarlet fever. *Streptococcus pyogenes.* Dia. 1-35,000 inch.
8. Cholera. *Spirillum choleræ.* Dia. 1-60,000 inch.

9. Anthrax. *Bacillus anthracis.* Thickness 1-25,000 inch.
10. Relapsing fever. *Spirochæte obermaieri.* Spirilla from the blood.
11. Influenza (La Grippe). Dia. 1-110,000 inch.
12. Pus. *Staphylococcus pyogenes aureus.* Dia. 1-35,000 inch.
13. Yeast fungus. Dia. 1-3,000 inch.
14. Glanders. *Bacillus mallei.* Dia. 1-60,000 inch.
15. Pneumonia. *Pneumococcus friedlander.* Capsulated micrococci.
16. Consumption. One tubercle containing spores.
17. Typhoid. Bacilli containing spores.
18. Anthrax (malignant pustule). Bacilli from blood.
19. Saliva. Various forms found in the mouth.
20. Asiatic cholera. Some joined in threads and some S shaped.

These disease germs shown in the 20 figures and enumerated in the accompanying list are so small as to test microscopical skill to the utmost. None but the highest powers and most costly objectives will reveal them and then only by means of stains and other aids. Some bacteriologists deny that the microscope alone can identify these different bacteria one from the other. Consequently they resort to what they call cultures in which they multiply indefinitely their numbers. The appearance and behavior of these colonies consisting of millions of single bacteria furnish a sure clue to their species. The effects produced in rabbits and other animals are also taken as proofs of their identity. As then the forms are so illusive even under the highest powers, they have not yet been fully described and classified morphologically, or in respect to the forms they present to the eye. While, therefore, the pictures we give are to some extent true, there are other bacteria not pictured here which, when pictured will not present a different appearance from some of these. In some cases of bacteria which look alike to the eye, one will stain easily with Aniline while another will not. For instance the Bacillus tuberculosis resists the stains which are effective with many species and requires special methods. Some bacteria will multiply when placed upon slices of raw potato, others will not. Some grow upon the surface of bouillon, others

not. By combining these various tests, bacteria may be identified when the microscope alone cannot do it. For understanding all these details, one needs a Manual of Bacteriology like that of Dr. Sternberg, or a little compend like that of Dr. M. V. Ball.

These minute organisms are present when the diseases named occur but some of them are sometimes present when the disease does not occur. Instead of saying that they cause the disease it is safer to say that when these germs find the system enfeebled or otherwise favorably disposed to harbor them disease is able to arise from the combined conditions, and it is quite certain that the several diseases could not occur provided the attendant germs were annihilated or kept out of the system.

These then are all communicable diseases and we should know in what manner the infection is transferred and so seek to avoid it. Happily we are able to say what the method of transmission is in many cases and to avoid it. For instance, we know that a consumptive has in his saliva millions of these germs, that if he spits upon floors, the ground, etc., the liquid soon dries up and the dried germs go floating in the air, to be breathed into the lungs of thousands of passers by. If the recipient is in sufficiently robust health no harm comes, but if the germ gets a start in the lungs it will multiply indefinitely and until death or cure ensues. Should every consumptive carefully preserve and burn all of his expectorations, the disease would soon be banished from the earth.

In 100 cases studied by one observer, it was found that 80 had been inoculated by occupying rooms which had previously been occupied by consumptives without proper methods of cleansing having been employed. Public drinking cups are another means of communicating infection.

The microscope has proved that we cannot live for ourselves alone. The interest of one is the interest of

all. He who goes through life casting his uncleanly product into halls, cars, shops, etc., himself will breathe in some other kind which some other careless person has thrown off in disregard of all human rights.

Typhoid and Cholera germs pass from the bowels of the sick with these diseases and in most cases of infection the germs have got into rivers, wells and drinking water. All this can be prevented if the discharges are disinfected with carbolic acid or burned.

Persons who die of diphtheria contain the germs and their bodies may taint the soil. In Normandy, such a body was exhumed after 23 years had elapsed. those who dug up the body and afterwards some other people were taken sick. A perfect epidemic of diphtheria resulted. This is why cremation is so strongly advocated by some people.

Milk from tuberculous cows is infected and there is no safety except in boiling the milk. The boiling point of heat kills the germs. If water is suspected it also should be boiled before using in food or as drink.

Health officers have found that there are at present five of these diseases which are very destructive when neglected but which yield readily to the means of control now known. These five are consumption, diphtheria, pneumonia, typhoid fever and scarlet fever. Dr. Gamber of the Michigan Board of Health has given the following synopsis of these five bacilli.

The bacillus of tuberculosis is the principal factor in the disease so commonly known as consumption, and is the cause of more deaths in the State of Michigan than any other single disease. Their shape is in the form of rods with rounded ends; average length, 1-10,000 of an inch; diameter, 1-100,000 of an inch. The bacilli are said to have an enduring form, and it has been demonstrated by experiment that it retains its vitality in desiccated sputum for several months. A susceptible individ-

ual may take this disease through an open wound, or an abrasion of the skin; but the respiratory tract furnishes the best medium for infection. A very common mode of infection, especially in children, is from the ingestion of milk from cows affected with tuberculosis. The temperature for the growth of this germ is 99° F., and they multiply slowly. The thermal death-point is 160° F.

The bacillus of diphtheria is the specific germ of that dreaded disease, diphtheria. They are rod shaped, straight or slightly curved, with rounded, club-shaped ends, having a length of 1-10,000 of an inch, and a diameter of 1-40,000 of an inch. Infection may take place from inhaling the poison, or where there is an abrasion of the skin; also from the food taken, and especially milk, which is a favorable medium for the growth of this bacillus. The development takes place at a temperature of from 70° to 107° F.; the most favorable temperature is 95° F. The thermal death-point is 140° F. The diphtheria germs have a great tenacity for life, may remain virulent for many months and tolerate the exposure to rain and sunshine during the months of April and May.

The micrococci of pneumonia are spherical or oval, usually united in pairs, or in chains consisting of three or four elements, which are srruounded by a transparent capsule. In length they are about 1-25,000 of an inch; diameter 1-35,000 of an inch. Infection from this micrococcus takes place through the medium of the respiratory passages. These germs are found in the saliva and nasal secretions in many persons in good health for days and weeks at a time,—perhaps they are waiting for the lungs to become irritated from a cold or from epidemic influenza so that it may cause its own specific disease, pneumonia. Blood heat, 98° F., is most favorable for their growth. The thermal death-point is 130° F.

The bacilli of typhoid fever have an average length of 1-12,000 of an inch, and a breadth of 1-40,000 of an inch,

with rounded ends. Their growth is most rapid at blood heat; thermal death-point, 140° F. They are long lived and will endure most any kind of weather, and find their way into the system through the medium of drinking water, milk or other food.

The pathogenic micro-organism of scarlet fever has not as yet, been fully demonstrated, but some good German and French authorities found in all these cases examined, a streptococcus identical with the streptococcus of erysipelas. Sternberg says: "In the diptheritic exudate frequently seen in the angina of scarlet fever a streptococcus is commonly found which appears to be identical with streptococcus pyogenes." Baumgarten believes these germs to be varieties of the streptococcus pyogenes. So that at present there seems to be no good reason for doubting that this is the specific infectious agent in scarlet fever, and enters the system by the mouth and nasal passages.

The streptococcus pyogenes is the specific germ in our severe cases of blood poison, and cannot be identified from the streptococus of erysipelas, but bacteriologists observe that the effects produced by them are somewhat different, as proven by the inoculation of the lower animals with artificial cultures of these germs. They are spherical in form, with a mean diameter of 1-35,000 of an inch. They multiply freely at ordinary room temperature, 60° to 70° F., but more so at blood heat. Thermal death-point is 130° F. This is also called the chain-coccus, on account of the arrangement in more or less elongated chains. Its peculiarity is to extend rapidly along the lymph spaces and lympthatic vessels; and if it commences about the hand it extends up the arm, and may cause progressive phlegmon, and often death, if radical measures are not taken to prevent it.

In this connection, attention may be called to the Hydrozone of Marchand as a specific for these diseases.

On Spontaneous Generation.

By C. A. McCAMM.,

ST. PAUL, MINN.

Beginning with Aristotle and for twenty centuries after him, men found no difficulty in believing in cases of spontaneous generation. They even believed that creatures as high in the scale of being as the frog were products of spontaneous generation. The discovery of the microscope dispelled a vast number of the beliefs that were held concerning it but also brought into view a world of life composed of creatures so minute as to suggest the probability of a passage from atoms to organisms. The difficulty in assigning an origin to the multitude of life found in liquids exposed to the air and in stagnant pools led to this theory. The scientific world was until late divided into two hostile camps upon this subject. Among the upholders of the theory were Buffon and Neadham and later F. A. Pouchet in France and Dr. Bastain in England. Among its opposers were Francesco, Redi and later Pastuer and Tyndall.

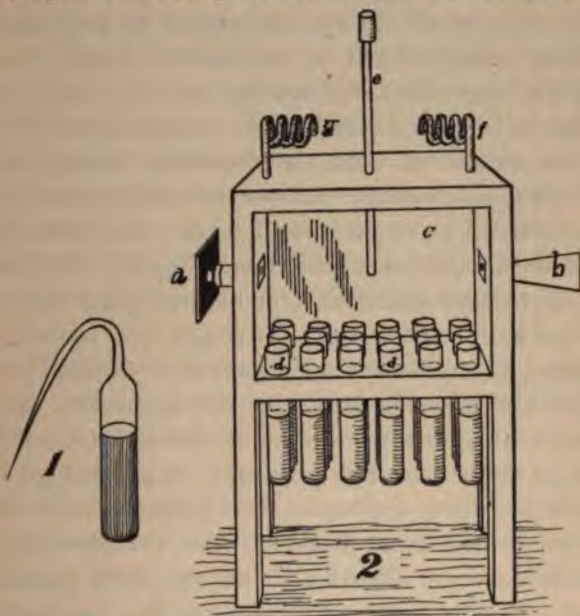
Redi proved that the magots which are found in putrefying flesh were produced by the flies which are always found buzzing around the meat and alighting on it. The magots, he thought might be the half developed progeny of the flies. The guess led to experiments which established its truth. But it remained for Tyndall to give the death blow to this theory. After years of most careful, intelligent and laborious experimenting he proved that the formation of bacteria was not the result of vital forces at work in the infusion itself but was due to contact of particles, which are found floating in the air, with the infusion.

He prepared sixty flasks containing infusions of beef, mutton, turnip and cucumber; these he packed carefully and transported to the Alps. The infusions were pre-

pared in the Royal Institution in London. He covered the substance from which the infusion was to be made, with distilled water kept at a temperature of 120° Fahr. After digesting the substance for four or five hours, he poured off the liquid, boiled it, filtered it and obtained a clear infusion. The liquid was then cooled and its specific gravity found. The flasks used were similar to that shown in Figure 1. These were filled by placing the tube in the infusion, heating the flask and then chilling it. The air within then condenses and is followed by the infusion. The flasks were then plunged in the boiling oil for five minutes, the steam escaping by the open neck. While the steam was still escaping a Bunson flame was applied to the neck and sealed it by melting the glass. The flask is then drawn from the oil perfectly sealed hermetically. Aster arriving at the Alps, 54 of the 60 flasks were found to be clear, the other 6 muddy but these on being carefully examined were each one found to have the nip of the neck broken off and hence admitted some air. The infusion in the muddy flasks was found to be crowded with life but which could not have been the result of spontaneous generation; or, if so, how account for the clearness of the 54? The fact that air was admitted into the 6 muddy ones and that these alone showed life tends to show if it does not prove that in this case ordinary air was necessary to the production of bacteria. But to prove that it is not the air itself, but something present in the air which produced the life, Tyndall went further. He divided the 54 clear flasks into groups of 23 and 27; the 23 he carried into a hay loft and broke off the ends of the necks admitting air. He then carried the 27 to a greater elevation in pure air and taking precautions lest any dust from his clothing or from the nippers should enter the flasks he nipped off the ends of the 27. He then placed the 50 flasks over a kitchen stove in a temperature varying from 50° to 90°

Fahr. and in three days he found 21 of the 23 flasks opened in the hay mow crowded with life. After three weeks of exactly the same conditions to which the 23 were subjected not one of the 27 had given way. The inference here is that it was not the air of the loft but something present in the air which produced the results observed in the 23 flasks.

For nearly 10 years, as he was able, Professor Tyndall was engaged in a study of the effects of radiant heat and



light upon gasses and his studies led to an important discovery. In a beam which illuminated the dust in his laboratory, he placed an ignited spirit lamp and around its rim were seen rims of darkness like an intensely black smoke but which was proved not to be smoke for a hot poker and a smokeless alcohol lamp produced the same appearance. The blackness was that of stellar space or the blackness resulting from the absence of all matter which could scatter light. The flame destroyed the float-

ing matter around it and the hot air from the flame arose into the beam and pushed aside the illuminated particles and substituted its own perfect transparency.

Tyndall brought this discovery to bear upon the study of spontaneous generation. He reasoned that if an infusion, barren, but susceptible of putrefaction when exposed to ordinary air was brought into contact with this non-luminous air it would never putrefy. To prevent the objection; that oxygen passed through a spirit lamp flame looses its vitalizing properties he performed the following experiment: a condensed beam was sent through a large flask containing air; the light revealed the dust in the jar. The jar was corked and left for a few days and examined with the luminous beam; no track was visible, the floating matter had settled on the sides of the vessel. Here he found a way of ridding the air of its floating matter without burning it. He then constructed wooden chambers (*c*) having glass fronts, side windows and back doors. Through the bottom of the chamber test tubes (*dd*) were passed air tight, their open ends within the chamber (*c*). He connected the inner and outer air by means of sinuous channels (*f. g.*) through which air could pass but no dust. A pipette (*e*) entered the chamber from the top. Every precaution was taken to prevent dust from passing into the chamber. The chamber was then closed and permitted to remain quiet for two or three days. Examined at the beginning by a beam sent through its windows (*a. b.*) the air was found laden with floating matter which in three days had wholly disappeared. The inside was coated with glycerine to prevent it rising again. The fresh liquid was introduced into the tubes by means of the pipette. The tubes were then put into a bath and contents boiled to destroy the infection which it had received from air before it was put in the tubes.

With such chambers, Tyndall tested infusions of the

most varied kind including natural animal liquids and the flesh of domestic animals, game, fish and vegetables. More than 50 chambers, each with its series of infusions, were tested, many of them repeatedly. The results were conclusive. In every instance he had perfect sweetness within the chamber which in some cases lasted more than a year. Without the chamber, with like infusions there was putrefaction and decay.

The conclusion here is: that an infusion deprived by heat of its inherent life and placed in contact with air cleansed of its visibly suspended matter has no power to generate life. But a further test was applied which clinched the argument. The tubes had remained in the chambers from 3 months to a year perfectly clear. The doors of the chambers were thrown open and the dusty air allowed to enter and in a few days the infusions were swarming with life. The liquids were therefore proved ready for putrefaction when the contaminating agent was present.

These experiments were so conclusive and so comprehensive that they gave a quietus to the doctrine of spontaneous generation.

The value of these results is seen from the immense practical benefit which has already accrued to science. Prof. Lister applied the principle to surgery with the result that operations, which 50 years ago involved elements of great danger and uncertainty can be to-day performed with perfect safety. Pasteur saved the silk industry of France through this principle and it is being applied to diseases with the prospect of furnishing an insight into the causes and of suggesting remedies for the most malignant diseases.

BIOLOGICAL LABORATORY OF HAMLINE UNIVERSITY.

The British Association meeting for 1894 will be held in August at Oxford, England and Lord Salisbury will preside.

A large attendance may be looked for.

THE MICROSCOPE.

New Series, 1893.

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CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

Transmitting Slides.—The tin-boxes in which the type-writer ribbons are packed are 3½ long by 1½ inches wide and make most excellent boxes in which to transmit slides. There is just room enough to insert the slides wrapped in cotton or in blotting paper and no damage can be done by the mailing or by the pressure to which packages are subjected in mail bags. This is of especial importance when slides are sent across the ocean.

QUESTIONS ANSWERED.

NOTE.—*Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of all grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.*

189. *How would you proceed to make a microscopical examination of urine suspected to contain spermatozoa?—C. S. C.*

Pour the urine into a narrow-bottomed wine-glass or similar vessel; let it stand several hours, until the spermatozoa etc., have fallen to the bottom of the liquid. Remove some of the deposit with a pipette, place a drop on a glass slip and apply a cover glass. Use a ¼ inch or 1-5 inch objective. If too much liquid be placed on the slip, the cover glass will slide about too freely. Then apply a small piece of blotting paper to the edge of the

cover and gently remove, by absorption, the surplus liquid. The cover will then lie against the slip so the microscope can be inclined to a convenient angle for a careful examination of the object.

PRACTICAL SUGGESTIONS.

By L. A. WILLSON,

CLEVELAND, OHIO.

Ringing Mounts.—For ringing mounts there is nothing neater, cleaner or more convenient for use than liquid shellac. Use the liquid pure without any admixture whatever. While the slide is upon the turn-table apply the liquid with a fine brush and finish with the point of a knife blade. Rings thus finished look almost as if made of solid glass. If a fancy mount is desired, paint a design on the slide and run the ring over it, as above. These rings make a handsome finish, which every one will admire. One can prepare the liquid himself. It may be obtained at a varnish factory or procured from dealers in microscopic supplies.

Leaves of Shepherd's Purse.—This is a very common weed, (*Capsella bursa-pastoris*), and has leaf hairs in the form of a cross and is but slightly inferior to Deutzia as an opaque mount.

Meridum Circulare.—This beautiful diatom may be found in the ooze on the borders of pathways in the woods and in natural parks. I have a gathering obtained in this way that is practically pure and requires no cleaning for mounting.

To be certain that you have this diatom, carry as a part of your collecting outfit a good strong pocket lens and a slide and cover glass, a compressorium or something of the kind. Place a drop of the gathering on the slide and cover, and view with the lens when the characteristic rings will be visible in the fresh material and with them will be observed separate cuneate frustules. The rings are characteristic on account of their width and disposition of the frustules about the center.

Keep Your Eyes Open.—A practical suggestion to the amateur microscopist who is a lover of nature and a devotee at its sacred shrine, is to keep your eyes open and examine every thing you find. Instruction and beauty will be everywhere un-

folded and you will be convinced that "there are sermons in stones and good in everything."

SCIENCE-GOSSIP.

Bacterium Coli Commune is considered by Ekehorn a cause of appendicitis.

Ice Dangerous.—However pure in appearance, ice may contain disease germs capable of development when taken into the system or brought into contact with food or drink. The evils attributed to the temperature of ice may be due to the germs.

RECENT PUBLICATIONS.

The Microscope and Microscopical Methods. By Simon Henry Gage. Fifth edition, rewritten, pp. 165, 8°. Ithaca, N. Y., Comstock Publishing Co. 1894.

The earlier editions of this work by Professor Gage have been so highly appreciated by students and teachers interested in the study of the microscope that a formal introductory announcement of the new edition is not necessary. The fifth edition, now before us, is for the greater part rewritten, more profusely illustrated, and much new and practical subject matter is added.

The book consists of 165 printed pages, the right hand page throughout the book being left blank for the insertion of notes. The subject matter is arranged in 280 numbered paragraphs which are divided into eight distinct chapters. These contain a clear and concise description of: (1) The microscope and its parts. (2) Lighting and focussing, manipulations of dry, adjustable and immersion objectives; care of the microscope and of the eyes. (3) Interpretation of the appearances under the microscope. (4) Magnification of the microscope, Micrometry. (5) Drawing with the microscope. (6) Micro-spectroscope and micro-polariscope, use and application. (7) Slides and cover-glasses, mounting, labelling, and storing microscopical preparations. Experiments in micro-chemistry. (8) Photo-micrograph, etc. Bibliography and Index.

In describing the various parts of the microscope and their functions, the greatest care has been taken to make perfectly clear all the terms used in connection with the microscope.

The more difficult technicalities are simplified by the aid of 103 illustrations, mostly original with the author, which gives a freshness to the pages rarely met with in books on this subject. Although it was written as a guide to laboratory students or a "text book on the microscope," it contains such a marvellous amount of concise information on the mechanism of the microscope that it is worthy of a place among the reference books of science.

This book is written by a man of high scientific attainments who is at the same time a devoted teacher. On this account every sentence has been weighed in two balances, first the one of exact truthfulness from a critical scientific standpoint and secondly the one of expression. This careful consideration of the Author has resulted in the production of an almost ideal guide to assist his and other students in acquiring those details in the knowledge of the microscope which he himself has labored so diligently to master. It is a text book that will aid the beginner and assist the teacher. To be sure most of the topics can be found more or less perfectly treated elsewhere, but so scattered and voluminous is the literature on the microscope that none but a *master* could select the "valuable from the worthless" and bring together *all that is essential* in a work of this size.

There are other works on the microscope more pretentious than this, but no other single book thus far written can take the place of this little volume in the library of the student, teacher, or physician who desires to know "how to use the microscope." It is written to instruct and consequently all necessary details are considered at length but in proportion to their importance. It is in the clear exposition of those details which are too frequently overlooked in works on the microscope that much of its excellence lies. The fact that in this little volume a teacher or student can find instruction on the simplest as well as the most profound technical part of a microscope and careful directions for the proper use of this instrument renders it one of the most practical books ever written on this subject. It is indispensible for the amateur and a most valuable aid for the student of science or medicine in the acquirement of a thorough, practical, knowledge of the use of the microscope.—V. A. M.

THE MICROSCOPE.

Contents for March, 1894.

THE MICROSCOPICAL JOURNAL.

Contents for March, 1894.

THE MICROSCOPE.

APRIL, 1894.

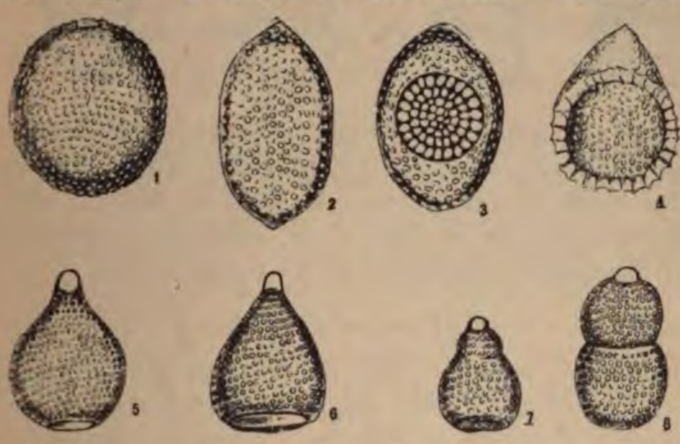
NUMBER 16. NEW SERIES.

Objects Seen Under the Microscope.

X.—SOME NEW FORMS OF RADIOLARIA.

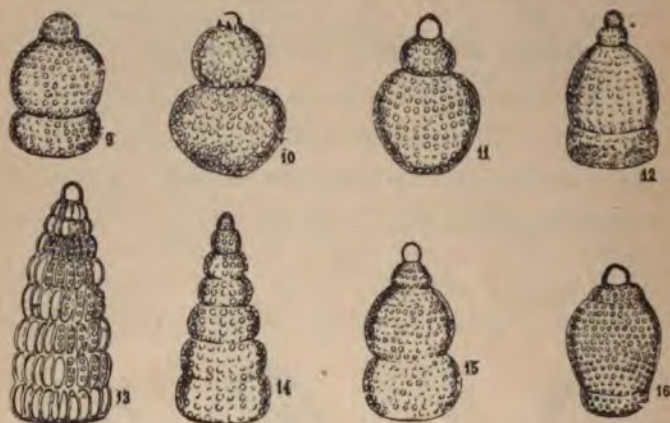
(FROM MANITOBA.)

To those not acquainted with the subject, we may say that these cuts illustrate the fossil skeletons of certain very minute and very low forms of animal life. The animals lived many thousand years ago and only their hard parts remain. Pictures of the animals when living



would look very differently. The Latin names of all these 16 different forms are of no popular interest but they may be found by those who desire them in the *Amer. Mo. Microscopical Journal* for April, 1893, where a description of each is also recorded. We insert these illustrations here to draw attention to the subject. Rev.

F. B. Carter has just finished in the *Journal* for April, 1894, a series of articles on the Radiolaria which are illustrated by 47 figures and which every one should have who wants to study Radiolaria. We have a few pieces of earth containing these forms which we will send out as premiums for new subscriptions. Directions for getting the forms which are too small to be seen until after



they have been dissolved out by chemical action may be found in the MICROSCOPE for February, 1894, page 29.

This earth was discovered in 1892 by the Canadian Geological Survey at Bell river, Porcupine mountain, Manitoba and sent to Germany for examination.

XI.—RED SNOW.

The objects figured below do not look much like red snow but they are highly magnified, and present a very different appearance in Nature. Every one is familiar with the green coloring often given to fences, stones, trees, etc., which are hidden from the sun's rays. The shaded side of houses, tree-trunks and walls is the favorite resort for the *Protococcus*. Suppose this growth red instead of green and suppose it located on ice or snow in the Arctic regions and you will have pictured to your

imagination what Red Snow looks like in Nature. But to know what it really is, consult an article in the *Microscopical Journal* for March, 1894, page 70 by Dr. A. M. Edwards of Newark, N. J., or you will find something in

Carpenter and in the Encyclopædias. Until the microscope revealed its true vegetable character and its mode of growth, the red snow was one of the omens of evil and gave rise to many superstitions.

Guano Examined Microscopicaly.

By ARTHUR M. EDWARDS, M. D.,

NEWARK, N. J.

To the younger microscopists of today the idea of examining by means of the microscope, the substance guano seems rather strange but it must be remembered that a true microscopist turns his searching wonder tube on everything. He searches the earth below him and finds wonders. He turns the tube to the waters and he sees them teeming with life. So he looks at the things that are common and finds in them worlds of amazement and delight. To the older microscopist a slide labelled "Guano d'Ichaboe" brings back the pleasure of the preparations of Bourgogne—he is gone now and sons, perhaps grandsons, occupy his place. But what is guano and what does the microscope tell us about it? And remember that the microscope, either simple or compound, is only a magnifying eye, an instrument making the eye,

and the mind too when it is properly used, more searching. If we look in an encyclopaedia to see what guano is, we find something like the following: We find that it is the excrement of birds and other aquatic animals that is found on the islands, more particularly in Peru in the Pacific Ocean, reddish in color and smelling strongly of ammonia and which is brought home by vessels for the use of the farmer as a manure. It was brought home by Humboldt in 1804, being found by him at the Chincha Islands and was in use during the 17th and 18th centuries by the inhabitants of Peru. It was analyzed by the German and French chemists Klaproth, Fourcroy and Vauquelin. But it was not until the publication in 1840 by Leibig of his work on agricultural chemistry that its uses in agriculture were proved. In 1850, no less then 500,000 tons were imported into England from Lima and it sold at about £13 per ton. An interest commercially in money value showed how important it was. Now it is being exhausted and although guano has been found elsewhere as at South Africa, (hence the name Ichaboe) and in the mid Pacific and in the Carribean sea it is now scarce to what it was. This is all very fine commercially, but why does the microscope turn to it to view it?

Some years since my attention was called to the subject of guano when engaged as an analytical chemist in examining the fertilizers of different kinds and thereafter when studying the Bacillariaceæ (or Diatomaceæ, as they are commonly but wrongfully called), and their applications to geology. At last I came to the conclusion that the prevelant notion with regard to the origin of guano was erroneous, for I wanted to find out the why and wherefore for all things. That was my failing, if I may call it so. My ideas of the subject were embodied in a communication made to the Essex Institute of Salem, Mass., on the 4th of January 1869, an abstract of

which will be found in the bulletin of the association, vol. 1, page 11. Subsequently with the Hon. E. G. Squier and Dr. A. Habel, who had visited the celebrated Chincha Islands, and there observed facts which confirmed the present writer's notions with regard to it, he again brought out the subject before the public at a meeting of the New York Lyceum of Natural History, held May 1, 1871. (Proceedings Lyceum Natural History, N. Y., vol. 1, page 224). Therein it is shown that guano is most likely not the excrements of birds and other similar animals deposited upon the islands and main land, but it is the result of the accumulation of the bodies of animals and plants, for the most part minute ones, Bacillariaceæ or Diatomaceæ making up the most part of the mass and subsequently upheaved from the bottom of the ocean by volcanic agency.

Dr. Habel who had visited the Chincha Islands for the purpose of studying geologically the mode of formation of the guano, said it presented itself as strata looking as if it had been laid down beneath water, and the uppermost portion was of a different character entirely. The strata are white and yellow varying in shade and thickness. The dip of the strata varies from five to fifteen degrees. The present writer said he brought the matter before the public first at a meeting of the American Microscopical Society in 1869, and had been fifteen years studying it as bearing upon the origin of certain infusorial earths which occur on the Pacific Coast as at Monterey and Los Angeles, and which extend into the State of Washington. These strata or shales are light in color being nearly white or salmon colored and contain the remains of Bacillariaceæ or Diatomaceæ and Polycistina. Along with these shells there is asphaltum present. But this is present also in Infusorial Earths at other points, as at Trinidad. The California State Geological Survey called the strata bituminous shales. Guano is not found

on the islands alone but on the main land and not only in rainless districts but in other districts, as in Alaska. The Chincha Islands have been visited by Mr. Kinahan, a competent geologist of Dublin also, and he has pointed out that they have been upheaved by volcanic agency within a recent period geologically speaking. Also the details of a residence at the same Island by Mr. F. Nash who states that the anchors of ships bring up guano from the depths of the sea. He says that an Island near Callao which was raised some years since by volcanic action had guano on it. The Bacillariaceæ or Diatomaceæ in guano are peculiar being very beautiful. At Ichaboe, in South Africa, they are brilliant discs seemingly of all the colors of the rainbow, but belonging to the genera *Actinocyclus Ehrenbergii*, *Coscinodiscus* and *Triceratium*, marine apparently beyond a doubt. Some day the ocean in these parts, on the coast of Peru, will be dredged to get the guano that is laying there.

Program of the Tenth Annual Soiree of the Washington Microscopical Society for May 8, 1894.

ADDRESS BY THE PRESIDENT, - - - DR. EDWIN A. GIBBS.

"THE USES OF THE MICROSCOPE."

Illustrated by Lantern Pictures.

EXHIBITS.

Exhibits	Exhibitor
1. Cancer, of muscle. 2. Miner's lung (anthracosis pulmonalis), showing deposit of carbon in lung tissue.	DR. G. N. ACKER.
3. Anthrax bacilli in kidney of guinea pig. 4. Yeast fungus (saccharomyces cerevisiae).	DR. W. W. ALLEGER.
5. Section of lymph gland of calf.	DR. E. A. BALLOCH.
6. Section of granite, showing component minerals, feldspar, quartz, mica, etc. 7. Macroscopical specimen of same rock.	MR. WM. BROMWELL.
8. Fatty acid from fish oil (by polarized light). 9. Scales of ferns (by polarized light). 10. Sections illustrating histology of human eye. 11. Sections of cancers. 12. Specimens illustrating pathology. 13. Sections of woody stems.	MR. HENRY H. BROWN.

14. Parasite of house fly.	MR. E. H. BOOTH.
15. Chain and sheet lightning.	MR. F. T. CHAPMAN.
16. Male mosquito, (culex pipiens). 17. Scalariform ducts, (root). 18. Medullary rays, (woody stem). 19. Pond life.	MR. P. C. CLAFLIN.
20. Blood corpuscles of frog (double stained).	DR. A. B. COOLIDGE.
21. Tongue of bumble bee.	DR. H. A. DOBSON.
22. Bud of moss rose. 23. Corolla of heliotrope. 24. Transverse section of bud of tiger lily. 25. Sori of ferns, showing development. 26. Anatomy of a leaf.	MR. H. H. DOUBLEDAY.
27. Crystals of silver nitrate, ammonium sulfate, copper sulfate, and sodium thiosulfate; also crystals in mica, all mounted in mica (by polarized light). 28. A colony of vorticella.	DR. RICHARD FOSTER.
29. Vorticella.	MR. JOHN GRINSTEAD.
30. Renal casts of Bright's disease (chronic parenchymatous nephritis).	DR. H. H. HAWXHURST.
31. A series of slides 32. illustrating various 33. species of hydroids.	MR. W. P. HAY.
34. Section from tumor of ovaries.	DR. H. L. E. JOHNSON.
35. Transverse section of spinal cord (human).	DR. J. MELVIN LAMB.
36. Bacillus diphtheriae (Klebs-Loeffler). bacillus.	DR. COLLINS MARSHALL.
37. Cyclops with parasites.	MR. L. M. MOOERS.
38. Web of frog's foot injected, showing the distribution of the lymphatics and blood vessels.	DR. V. A. MOORE.
39. Vase of flowers composed of diatoms and butterfly scales. 40. Trichina spiralis. 41. Transverse section of bone (human) stained.	DR. ROBERT REYBURN.
42. Section of kidney (human), injected. 43. Polycystina, collected off the coast of the Barbadoes Islands. 44. Nematoid worms (coccidium oviforme) in liver tissue.	DR. J. H. RINDLAUB.

IV.—FINISHING.

1. Date as above.
2. Place mount upon turn-table.
3. Ring with shellac cement.
4. Put aside for thorough drying.
5. Place mount upon turn-table.
6. With cut-edged needle cut away any irregularity in outer edge of shellac ring.
7. Cover with zinc-white cement.
8. After about 5 minutes ring with any color of lacquer cement (King's) to suit taste.
9. Put aside to set and dry.
10. In about a week polish slide, put on labels, copying any dates of importance you choose and remove date slips from under side by wetting.
11. Result: a beautiful slide.

The Size of a Spider's Thread.—Leuwenhoek, the first microscopist, wrote in 1685 as follows:

I have often compared the size of the thread spun by full grown spiders with a hair of my beard. I placed the thickest part of the hair before the microscope and from the most accurate judgment I could form, more than a hundred of such threads placed side by side could not equal the diameter of one such hair. If, then, we suppose such a hair to be of a round form, it follows that 10,000 threads spun by the full grown spider, when taken together will not be equal in substance to the size of a single hair.

To this, if we add that 400 young spiders, at the time when they begin to spin their webs, are not larger than a full grown one, and that each of these minute spiders possess the same organs as the larger ones, it follows that the exceedingly small threads spun by these little creatures must be still 400 times slenderer; and, consequently, that 4,000,000 of these minute spiders' threads cannot equal in substance the size of a single hair.

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CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

An Anti-Dissection and Vivisection Writer.—One of the kindest hearted of men is Geo. T. Angell and one of our most enterprising exchanges is "*Our Dumb Animals.*" It contains many nice little stories of kindness to animals, of sagacity, etc. Whatever it says and does in a gentle spirit is mostly good. But, by reason of unbalanced thought, many flies are mixed in the ointment. This kind hearted man sometimes seem devoid of common sense when he attacks cruelty, real or imaginary. Along side of the beautiful persuasive stories; he prints the most infamous rot regarding vivisection, dissection, check-reins, etc. At the same moment, the paper is a white-winged messenger of peace, and a crazy bomb thrower. Thousands, who could be benefitted and pleased by its virtues, will discard it in disgust as of "no good" when they see its faults. By its indulgence in crankiness it curtails its power for good many fold, greatly to our regret. Why be so unbalanced in your thoughts, Bro. Angell? You violently antagonize the work and opinions of men of high standing, when, were you more modest you would go slower. You alienate the sympathy of many influential men when you ought to prize it. You make statements so exagerated as to tempt people to give you the lie. You say that putting a mouse under a bell-glass and exhausting the air in a public school is "useless, barbarous and demoralizing" *to the teachers.* You say "it might be useful to teach children to carve chickens"

but you denounce all dissection of cats even in high schools because as you say "not over one child in a thousand has a bent for zoology."

Mr. Angell sends out a "beautiful placard" containing the exhortation: "Don't ride in any vehicle drawn by a poor-look-horse," but in all his literature we find no allusion to withdrawing patronage from poor looking men, women or children. Why not be consistent in your folly, Mr. Angell?

Illustrations might be multiplied of these unfortunate lapses in common sense. The one which really led to our writing this article, may close our remarks. In his April number is an article of nine lines headed "Cornell University." He first quotes some one as saying that Prof. Bert G. Wilder in his "Physiological Practicums" has published explicit directions for examining portions of the cat, and the heart, eye and brain of the sheep as an aid in the study of elementary physiology. His comment thereon is: "The whole freshman class at Cornell came near being murdered recently by scientific suffocation, which caused the death of the poor woman serving them." We call on Mr. Angell in the name of every friend of this distinguished anatomist to either withdraw or to justify this inuendo which on its face appears senseless and cowardly.

QUESTIONS ANSWERED.

NOTE.—*Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of all grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.*

190. *Can vegetable sections which contain crystals be mounted in balsam or glycerine, without destroying the crystals?—H. A.*

Plant crystals are commonly composed of oxalate of lime, which is unaffected by balsam or glycerine.

191. *Will you kindly inform an amateur where to find amœbas and stentors, and the method of obtaining them?*

Amœbas and Stentors may be found in shaded, mossy pools of water. In winter they may be found in the green moss growing on the stones etc., in aquaria. Pick up a morsel of the moss with a forceps or small scoop, place it in a small cell or on

a glass slip with a concave centre. Examine with a low power. If the find is rich, lay on a cover and examine the moss and contained water with a ¼ inch objective. See A. M. M. J., vol. X, page 151, for an article on amœba.

PRACTICAL SUGGESTIONS.

By L. A. WILLSON,
CLEVELAND, OHIO.

Metallic Crystals.—Crystals prepared in the following manner are brilliant and gorgeous opaque objects. The Copper is the most beautiful. They are easily produced and no microscopist should be without a few of these slides, especially when he desires to excite the unfeigned admiration of his friends.

Place on a cover a solution of the chloride of tin, silver, gold, platinum, copper or lead. The tin crystals will be precipitated by placing a little pencil of cadmium on a cover with the solution. Silver may be thus precipitated from the nitrate with arsenic, antimony, zinc, lead, iron or copper. Copper from the chloride with bismuth, zinc, lead, tin or iron.

Gold from the chloride with all those mentioned for silver. The precipitating metal must be a little metallic bar laid on the cover containing the proper solution. Mount in balsam, between two covers, then cement on a bed of asphalt and ring with shellac to prevent the asphalt from running in, and after drying finish with asphalt.

Pollen Tubes.—Claytonia Virginica or Spring Beauty, now in blossom in the woods, furnishes an easy specimen for the exhibition of pollen tubes. In order to see them, sever the style and view the three stigmas. The tubes will be visible in the grain adhering to the stigma. To see them a quarter inch objective will be the most serviceable. All the great works on botany assert that to accomplish fertilization the pollen tube descends into the ovary and comes into actual contact withth e micropyle of the ovule. A few skeptics have doubted the assertion whereat the authorities became wroth and declare that non-experts cannot see or know anything about the matter and nothing but highly expert manipulation can demonstrate the truth. In Claytonia the tube is very distinct and to the non-expert it looks equally as plain that the tube does not descend

to the ovary but that each tube is intimately attached to a stigmatic process, and it looks as if these processes acted as haustoria and that the act of fertilization was carried on by suction and absorption.

Here is a field where the amateur microscopist may win immortality.

Quick Methods of Staining Tubercle Bacilli.—Take the sputum of pulmonary consumption or one of the little tubercles found therein; thinly spread on cover-glass in air, pass thrice through spirit lamp flame to fix. Stain five minutes in Nelson's Dye, (Fuchsine 1 part, 5-100 aqueous solution of Carbolic acid 100 parts, alcohol 10 parts, mix and filter) wash in acid alcohol (hydrochloric acid 1 part, alcohol 10 parts) until decolorized, dry on hot glass slide and mount in warm pure balsam.

The whole process can be easily completed in half an hour. If a double stain be desired use Baumgarten's Quick Method:

I.—Cover-glass prepared as aforesaid.

II.—Float for three minutes on the following steaming hot, in a watch glass. Aniline aq. 2 parts, saturated alcoholic solutions of fuchsine 1 part, mix.

III.—Then 4 to 5 minutes in the following:

Distilled water 50 parts.

Alcohol 30 parts.

Nitric acid 20 parts.

Methyl Blue to saturation, mix.

ANOTHER METHOD.

Prepare cover-glass as above stated. Stain in warm carbolic fuchsine, then pass the cover-glass to and fro through water at nearly the boiling point until but a faint rosy tinge remains. One or two minutes are usually sufficient and the specimen is ready for immediate examination.

Arranged Scales of Synapta.—A veritable "Oh My" slide can be prepared by arranging the anchors and plates of Synapta as an opaque mount. Mount them on a dark background in a deep cell; arrange in a circle with the rims of the anchors pointing outward and the plates toward the center. Four plates in the form of a cross in the center, with an anchor at each extremity of the cross and an anchor at each angle will make a beautiful and instructive slide.

SCIENCE-GOSSIP.

The Midland Naturalist, until recently published at Birmingham, England, has been obliged to suspend publication owing to the lack of support. We have not heard of any liquor shops closing for lack of support.

The American Medical Association will meet in San Francisco, June 5, 1894. Odd Fellows hall and 12 smaller halls have been engaged for general and sectional meetings. R. H. Plummer, 652 Mission street will give information.

RECENT PUBLICATIONS.

An Introduction to Structural Botany. By Dukinfield Henry Scott. London and New York. Macmillan & Co. 12 mo. pp. 288, figures 113. Price $1.00

Perhaps you think a dollar book not worth much. In this case it would be a grave mistake, for the book is worth two dollars. Everything about it is in the bookmakers best style.

The author has hit upon an excellent idea—that of describing something in plain language and then giving the technical name. The whole treatise consists of a series of the most lucid definitions but no technical word is used until its meaning has first been made clear in the narative. Hence we pronounce the style simply suberb.

To the microscopist the book is of interest as explaining fully what is to be seen in plant life by means of the microscope though the author alludes to the microscope only incidentally.

Were we starting a class in botany, this book would be our text book. Should some isolated student ask what book to use to enable him to learn plant structure we should refer him to Dukinfield Henry Scott. Should we find young people analizing plants so as to learn their classification, we should tell them to take only the three plants which this book is based upon and read the physiology and morphology as therein set forth as of intensely more interest than the mere naming of a host of plants by external characteristics. We shall await Scott's second volume on the Cryptograms with intense interest. It will be a success.

THE MICROSCOPE.

Contents for April, 1894.

THE MICROSCOPICAL JOURNAL.

Contents for April, 1894.

THE MICROSCOPE.

MAY, 1894.

NUMBER 17. NEW SERIES.

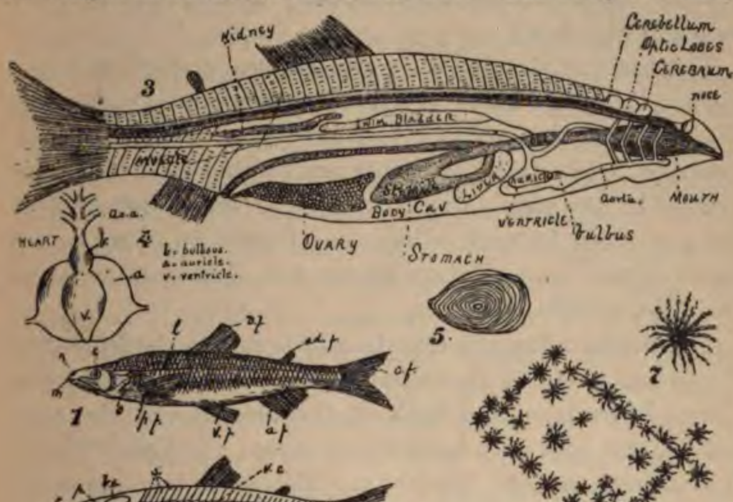
Objects Seen Under the Microscope.

The Smelt (Osmerus mordax.)

BY LAWRENCE E. GRIFFIN & EDITH MONTGOMERY.

Biological students in Hamline University.

The Smelt is a salt-water fish, of the family Salmonidæ, found along the Atlantic shores of the United Sates. Its length is from six to nine inches. The body is nearly



round in cross-section and quite slender. It is dark on the dorsal side, shading into silvery white on the ventral. Extending from just back of the eye to the root of the caudal fin, along each side of the body, is the metal-

lic blue median line, Fig. 1, l. The head is about one-fifth the entire length of the body. The jaws are large and well supplied with teeth which point back toward the throat. The teeth are not set in sockets. The tongue and palate are also armed with teeth.

A thin long flap, the "operculum." at the back of the head covers the gill chamber, Fig. 1, o. This as well as the fins and scales point back, and in this way afford no resistance to the passage of the fish through the water. The sharks and some other fishes have no operculum. In the case of the shark there are on each side, just back of the head, five vertical slits.

The eye is round and without lids; the pupil large and the iris silvery. Near the tip of the nose on the dorsal side of the head, are two pits covered with a thin membrane. These are the nostrils, they do not open into the mouth, (Fig. 1, n).

The fins are divided into two classes, paired and median. The paired fins are the Pectoral and Pelvic fins. The Pectoral fins (Fig. 1 p. f.) are just behind the gill-chamber, while the Pelvic fins are further back and more ventral in position (Fig. 1, v. p). In many fishes these fins are close to each other, the Pelvic fin being sometimes almost immediately under the Pectoral, or, as in the Sole, a little ahead.

The median fins are four in number, viz., the Dorsal on the dorsal line and about half way back, the Adipose fin; dorsal in position and back of the Dorsal fin; the Anal fin, ventral, and just back of the anus; the Caudal fin at the extreme end of the body. The back bone does not extend into the caudal fin (homocercal).

The adipose fin is a fleshy, rayless fin peculiar to the Salmonidæ. All the other fins are rayed, and each fin has always a certain number of rays. Thus the number of rays in a fin helps to determine the species of the fish.

The shape and arrangement of the fins varies much in

different species. In the Cod, the dorsal fin is divided into three distinct parts and the anal fin into two parts. The Bass has an extremely long dorsal fin, extending almost the entire length of the back, and in the Sole the anal fin extends from the anus to the tail, the anus in this case being almost directly under the operculum.

The position of the anus differs very much; in some species being far forward, and in others being far back. In some Australian and Queensland fishes, the paired fins instead of being rayed, have a central bone, with others branching from it in much the same manner as the veins of an elm leaf. The fins are also of nearly the shape of this leaf. The scales are small, and when viewed with the low power appear to consist of concentric rings "cycloid scale" (Fig. 5).

1. In the dermis beneath the scales are situated the pigment cells which give the skin its colors. These may be easily seen by mounting a small piece of the dermis and viewing with the low power. The cells are stellate, of a dark color, and upon the dorsal side very numerous and well developed, (Fig. 7.) but almost lacking on the ventral side. The cells are arranged in diamond shaped groups (Fig. 6). In the dermis are two sets of parallel fibres which cross each other obliquely. These are known as white fibrous connective tissue. They may be seen quite plainly with the high power glasses. When irrigated with acetic acid (1 per cent) the fibres disappear, this being the characteristic reaction of this tissue.

2. The mouth connects directly with the œsophagus, there being no separate throat. Salivary glands are also lacking. The stomach is quite large, and the intestine leaves it at the upper end, makes a half turn, and then runs straight back to the vent (Fig. 3). There is no large intestine and probably no distinct pancreas.

The liver lies just in front of the stomach. A short distance in front of stomach, the ductus pneumaticus,

connects the swimming bladder with the œsophagus. The food of the smelt is composed of small fishes, or, the marine animals. Nereis is commonly found in its stomach. The spleen is a dark colored organ lying above the œsophagus and in front of the swim-bladder.

3. Just in front of and below the liver is the heart. This organ is red in color and has three parts, one auricle and ventricle and the bulbus arteriosus. The auricle is thin walled and nearly surrounds the thick walled ventricle (Fig. 4). In front of the ventricle is the "*bulbus arteriosus*" from which runs the aorta. The aorta goes forward to the gills and sends off a branch to each side, at every pair of gills. The blood passes upward through the gills, and in its passage is aerated. The branches of the aorta running around the gills, form what are known as aortic arches. The blood is gathered at the top of the arches into the dorsal aorta, and by it is distributed throughout the body. The aorta runs along the under side of the back bone to the tail. The small veins collect the blood, lead it to the cardinal veins, and by these it is carried back to the heart. There is a cardinal vein on each side of the body. They are divided into two parts, the anterior and posterior cardinals. The anterior cardinal collects the blood from the head and parts in front of the heart, while the posterior cardinal collects the blood from the regions back of the heart. The cardinal veins enter the auricle upon the right and left sides. By the contraction of the auricle, the blood is forced into the ventricle, from the ventricle to the bulbus and so upon another round.

The portal vein collects the blood from the alimentary system and leads it to the liver. From the liver the hepatic vein takes it to the heart.

4. The gills are the respiratory organs of the fish. Water is taken into the mouth and passed out through the gills. Some of the oxygen is extracted and supplies

the blood in the gill. The gills are soft bodies of a loose cellular structure supported by the branchial arch.

In a few species of fish (e. g. *Lepidosiren*,) the swimming bladder seems to act as a lung. It is filled with a spongy cellular structure, and the blood is passed through this and aerated as in the lungs of mammals. But in most cases this is not so. In most fish the ductus pneumaticus is permanently closed and as this is the only passage into the swimming bladder it precludes the possibility of that organ being used as a lung.

5. The chief use of this bladder is not then as a lung. What effect it has upon the swimming power of the fish is not positively known. It may be that by its contraction or expansion the fish can determine the depth to which it shall sink. It is on the dorsal wall of the body cavity, above the stomach.

6. Just back of the swimming bladder and also dorsal in position is the kidney. This is a dark red, spongy organ, and connected with the anus by a straight duct.

7. The muscles of the back are very strong, while those of the fins are weak. As the fish swims by flexion of the back, and uses the fins mainly for balancing, this development would be natural. In mammals, which use the limbs for locomotion; the contrary is the case. The muscles are made of sets of fibres, and the individual fibres are composed of still smaller parts called fibrils. They are composed as if successive short lengths had been laid down in the process of growth. The whole is contained in a very delicate membrane—the sarcolemma. The successive growths give a striated appearance to the fibril. The high power glass must be used to distinguish these facts. Close to the wall of the fibrils, at nearly equal distances from each other, are nuclei, from which threads of protoplasm extend throughout the fibrils.

8. The brain is composed of the following parts : the

olfactory lobes, cerebral hemispheres, optic lobes, cerebellum and medulla oblongata. The brain is situated between the eyes and is protected by a case of cartilage, and above this by two long, thin and narrow bones.

The olfactory lobes being anterior, the other parts follow in the order named. The olfactory lobes are two in number, right and left olfactories, and connected with the nostrils by the olfactory nerves. The optic lobes, right and left, as on the central hemispheres also, have connection with the eye through the optic nerves.

The eyeball is nearly spherical, and movable in its orbit to a slight degree. The pupil of the eye is the central opening of the iris, which is a pigmented diaphragm stretching across the interior of the eyeball, and about one-quarter the distance from the front of the eye to the back. In front of the pupil is the transparent cornea, and between this and the iris is the aquæous humour, a transparent watery substance. Immediately back of the pupil is the crystalline lens, bi-convex, and surrounded by muscles which can render the lens more or less convex.

The back of the eye-ball is covered with a silvery membrane, the sclerotic coat. Within this is the dark choroid coat. The optic nerve enters a little to one side of the back of the eye and spreads over the inside of the eye forming the sensitive retina. The chamber back of the crystalline lens is filled by the vitreous humour, a transparent jelly-like substance.

The optic lobes are covered by the pia mater; a thin pigmented membrane. The cerebellum is a single mass slightly constricted along the median line from front to back. The medulla oblongata is a little beneath the cerebellum, and extends posterially to the spinal canal, where it becomes the spinal cord.

9, The Spermaries are two large, white bodies, situated in the back part of the body cavity, distinguished

as right and left spermaries. A duct leads from the spermaries to the anus. The ovaries of the female are placed in the same relative position, and are known as the right and left ovaries. The color of the ovaries is yellow, while that of the spermaries is white.

The eggs are found in the ovary in different stages of developement. Some almost fully developed and others in the first stages are totally undeveloped (Fig. 3).

The ova are all enclosed in a fine porous membrane—the vitelline membrane. Among the ova may be seen many minute drops of oil. By placing the ova in ether for a few hours the oil is completely extracted. The undeveloped ovum contains simply the nucleus and protoplasm. In the developed ova the protoplasm has formed a net work throughout the ova, and the interstices are filled with yolk.

10. The back-bcne extends from the head to the root of the caudal fin (Fig. 2). It is made up of a number of vertebra. Each vertebra bears two or more spines, according to its position. The vertebra itself is called the centrum, and is, in cross section, almost square. The centrum is slightly longer than it is broad. The ends of the centra are concave and a canal runs longitudinally through the centra. This canal contains the noto cord, a cartilaginous body, which swells out at the junction of two centra and fills the space caused by the concavity of the ends.

From the top of each vertebra rises a spine, (the neural spine.) To form this spine it seems as if a spine had grown upward from each side of the centrum, and after a time had joined, forming a canal at the base of the spine, through which runs the spinal cord. Until the body cavity is passed the centrum bears a curved spine or rib on each side. Back of the body cavity there are no ribs, but the centrum bears a ventral spine, shaped as the neural spines, and through the haemal arch runs

the aorta. The gills are each supported by a bony arch, formed by three bones. One extends down and back and out from the roof of the mouth for a short distance. The next is jointed to the first, and runs in and down until under the floor of the mouth, and the next bone joins this to the hyoid bone. These bones form the Branchial Arch and support the soft tissue of the gills. These bones also bear teeth, or gill-rakers, to prevent food from escaping between the gills.

Models for Constitution and By-Laws of a Microscopical Society.—III.

[In 1893 there were presented the Constitutions of the Washington and San Francisco Societies, pp. 69, 133. Others are desired for use in this series.—EDITOR.]

CONSTITUTION OF THE MICROSCOPICAL SOCIETY OF BELGIUM.

ARTICLE I.—GENERAL PROVISIONS.

SECTION 1. This Society is called *La Societe Belge de Microscopie.*

SEC. 2. The object of this society is to cultivate a taste for microscopical studies, to cause the utility of microscopy to be appreciated; to contribute to the progress of science by publications, by making collections and forming a library; and by such other methods as may be deemed expedient. The Society studies the subject of micrography in its widest sense including all the medical, natural and industrial sciences.

SEC. 3. The Society has its headquarters at Brussells.

SEC. 4. The Society can be dissolved only by the consent of four-fifths of its active members. The last general assembly which shall declare the dissolution, shall dispose of the collections, the library and the archives to some scientific establishment.

SEC. 5. There can be no modification made in this article of this constitution without the consent of four-fifths of the active members, called together by the Executive Council in a general assembly convoked especially for this purpose. If in this first assembly there are not a sufficient number of members present

to form this majority so that they can legally transact the business, a second meeting may be called in the same manner as the first, one month from that date, and the questions presented in the same manner as at the first meeting and be decided by a majority of four-fifths of the members present.

The following articles can be changed at a general meeting called especially for this purpose by the Executive Council and with the consent of three-fourths of the active members present at the meeting.

ARTICLE II.—MEMBERSHIP.

SEC. 6. The society is composed of an unlimited number of active and associate members.

The election of active and associate members belongs to the general assemblies after nomination by the Executive Council. A majority of votes upon secret ballot shall elect.

SEC. 7. The Diploma of honorary or corresponding membership can be awarded to persons who have rendered or who are able to render some service to the society. The number of honorary members is limited to fifteen, that of corresponding members to forty. The right of electing honorary and corresponding members belongs to the general assemblies of the society after their nomination by the Executive Council.

The honorary and corresponding members have the same right as the active members to be present at the meetings and to speak upon scientific questions.

No one can become an associate member of the society if he is less than fifteen years of age or more than twenty-four, and associate members are not permitted to participate in discussion.

SEC. 8. Active members pay an annual fee of three dollars; associate members, one dollar; non resident active members can substitute for the annual fee a single payment of forty dollars.

SEC. 9. All members can examine the specimens, books, &c., of the society if they comply with the special regulations. Active and honorary members are each entitled to one copy of the Annals of the Society. Corresponding and associate members are entitled only to the monthly bulletin.

SECTION III.—MEETINGS.

SEC. 10. The members of the society meet in a general assem-

bly upon the second Sunday of October in each year, at 11 o'clock A. M., in the rooms of the Society at Brussells.

The order of business at this meeting is as follows:

1st. To hear the report of the Executive Council upon the condition of the society.

2nd. To audit the accounts.

3rd. To fix the days for the monthly meetings of the society.

4th. To deliberate upon the propositions submitted to it by the Executive Council or which are proposed by any nine active members.

5th. To elect by secret ballot a President, the Vice-Presidents, the Secretary, the Treasurer and the members of the Executive Council.

All decisions made by the general assemblies shall be by the majority vote of all the active members present.

Sec. 11. The Executive Council has the right to call together the general assembly in extra session. It is its duty to do so after one month's notice upon the written request of twelve active members.

Sec. 11½. All calls for extra sessions must be sent to the members at least fifteen days before the date fixed for such meeting. This call must indicate in detail the questions upon which the assembly is to be called upon to deliberate, and no decision can be made upon any questions that were not contained in the program for the day as set forth in the call.

ARTICLE IV.—ADMINISTRATION.

Sec. 12. The society shall be governed by an Executive Council, which shall represent it. This council shall be composed of a President, two Vice-Presidents, a Secretary, a Treasurer, a Curator, (Librarian) and four members.

Sec. 13. It shall be the duty of the Council to take such measures and make such regulations as shall assure the prosperity of the society, order in its work and publications and preserve its collections, library, furniture, &c. Its decisions are valid only when they are taken by the absolute majority of all its members.

Art. 13½. The Council shall elect each year an assistant Secretary and an assistant Curator--Librarian. The duration of

their term of office shall be one year and they shall be eligible to re-election.

The President is elected for two years and he is not eligible for immediate re-election.

The other members of the Executive Council are also elected for two years, one half are to be changed each year and they can be immediately re-elected.

THE MICROSCOPE.

New Series, 1893.

For Naturalists, Physicians, and Druggists, and Designed to Popularize Microscopy.

Published monthly. Price $1.00 per annum. Subscriptions should end with the year. The old series, consisting of 12 volumes (1881–1892), ended with December, 1892. Sets of the old series cannot be furnished. All correspondence, exchanges, and books for notice should be addressed to the Microscopical Publishing Co., Washington, D. C., U. S. A.

CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

A Lady Miscroscopist for 50 Years.—We have always taken the ground that the microscope is peculiarly adapted to the fair sex. We have always indulged the hope that among American ladies the use of the microscope would be as common as that of pianos, organs, and that the music of the eye in beholding the harmonious combinations found by microscopy might be equal to the music of the ear produced by vocal and instrumental culture for introduction into the best circles of intelligent society. It is then very pleasant to announce that an English lady, Mrs. Jenny Spottiswoode, 1 Lunham road, Upper Norwood, London, has cultivated for more than half a century the charms, pleasures, delights, intellectual cultures, and uplifting influences of microscopical enjoyment. Fifty such years have not cloyed her tasts as the following extracts from a late letter of her's to an American friend are a proof:—

"I think the taste for it (Microscopy) is born with one. It is

distressing to me to show an object to any one who simply tells me "Oh how pretty" and nothing more. * * * * I so often wish you were in England and that we could have a good day's work at the microscope. Photography (micro) is made so easy *now*, to what it used to be when I used to work at it. I have now under the microscope tadpoles and frogs. I love to see *their* internal economy. Intestines are so beautiful and the eye is like a jewel; and its pigment and the whole body masses of jewels; and then the gills are a study of circulation. I have examined the tadpoles of toads and tadpoles of Newts." Her statement shows that love and enthusiasm for micrographic work does not die out with age and must be very desirable when confined at home by an accident impeding locomotion as Mrs. Spottiswoode was at the time of writing. Dr. Holmes said he was eighty years "young" (not old) and he taught me microscopy. So can Mrs. S. say, "I am seventy years young, kept so by the inspiring and enthusing power of the ideas attained by the use of the microscope in studying and comprehending the hidden glories of Nature.

PRACTICAL SUGGESTIONS.

By L. A. WILLSON,

CLEVELAND, OHIO.

Uncinula necator.—This is the powdery mildew of the grape and is generally known as *Uncinula spiralis* and in Europe as *Oidium tuckeri*. It is easily obtained and makes a beautiful specimen for the microscope. Doubtless, nearly every one has noticed the little cob-webs in the corners and angles of a bunch of grapes. It is almost ever present on grapes kept during the winter. This "cob-web" is the mycelleum and perithecia of the fungus. Take off a small portion with forceps, place on a glass slip in a little hydrate of potasium, cover and examine first with an inch and then with a quarter inch objective. The perithecia are round, dark and prettily reticulated; each has from ten to twelve appendages. These appendages are long and curved at the ends like a shepherd's staff. After softening with the potash solution, press upon the cover. This will split the perithecia and expose the asci. Each ascus contains from four to six round spores. To make an acceptable mount let

eosin run over the specimen as prepared above until the object is flooded. Let it soak from half an hour to an hour. Then with forceps remove to a clean glass slip; then float in alcohol; when the alcohol evaporates float in turpentine and under a dissecting microscope see that the stained film is nicely spread out. Then mount in balsam. You will have a slide worth seeing and one that is not common.

Etching Labels on Slides.—This may be easily accomplished and will produce better permanent labels than can be written with a diamond. Coat a clean slide with bees wax by heating in the flame of a spirit lamp and spreading the film of wax evenly. Trace the design with a needle through the glass, in a little shallow lead dish one half inch deep and four inches long and three inches wide, place a teaspoonful of powdered fluor spar and one half ounce of strong sulphuric acid. Across the top place the slide or several slides, wax side down. Smear the opposite side with vasiline and let it remain over night. In the morning remove the wax with turpentine or chloroform and the label will be permantly etched. Care must be taken while performing the experiment as the vapor of hydrofluoric acid generated is in the highest degree corrosive and its action upon the human system is highly deleterious. The same result can also be obtained in the course of a few minutes by a gentle application of heat to the cup containing the mixture.

To Obtain and Mount an Embryo Chick.—Take eggs that have been partially incubated. By taking eggs which have been set for different lengths the progress of incubation may be watched and studied. To see the embryo, crack the shell upon the side over an area as large as a half dollar; then pick away the pieces of the shell piecemeal without disturbing the tough membrane just within. The latter must be carefully torn away with forceps and the embryo will be found upon the upper surface of the yolk with its axis at right angles to that of the egg, with its head away from the observer, if the smaller end of the egg be toward the right.

With sharp scissors the vitalline (yolk) membrane is pierced and a circle cut about the embyro just about the limiting vein of the vascular area. On immersing the egg in a 75 per cent salt solution at about 99° Fahrenheit, the blastoderm will float and may be slipped upon the slide and with a pipette

gently forced from yolk particles and the overlying portion of the vitalline membrane. It is then drained until flat and without creases, dried with gentle heat until the edges will just adhere to the slide, then immersed in 1 per cent osmic acid for three minutes or until the preparation begins to turn black; it must then be thoroughly washed in distilled water, placed for several days in a considerable quantity of Muller's eye fluid, washed again, passed through alcohols of increasing strength, cleaned and mounted.

Muller's fluid consists of

Bichromate of potassa	2 grammes.
Sulphate of soda	1 gramme.
Distilled water	1 gramme.

The specimen thus mounted is suitable for low powers, a two inch or one inch objective, and is an exceedingly interesting specimen in embryology which will be explained in any good work devoted to that subject.

A Good Way to Mount Mosses.—If the specimen be one that has been gathered for some time, cut a sprig of proper size for mounting, wash the sprig in water, then spread out upon a plain glass slide, wipe away the superfluous water; then cover with another plain slide, bind the two slides with a strong spring clip and set away to dry; let it thus remain at least a week. The specimen will then be dry and the parts will be nicely spread out and displayed. Then place in a shallow cell and mount in balsam. If the moss be green and fresh, first wash in water, then put between the leaves of an old book or in a flower press and leave until dry before mounting. This latter method is good for mounting florets of the Compositæ or Sunflower order of plants.

RECENT PUBLICATIONS.

Sir Francis Bacon's Cipher Story.—Discovered and deciphered by Orville W. Owen, M. D. Vol. 1. Detroit and New York. Howard Publishing Co., 8° pp. 198. Paper 50 cents.

Our author claims to be able to transpose all the plays of Shakespeare, Robert Green, George Peel and Christopher Marlow; the Fairy Queen, Shepherd's Calendar and all the works of Edmund Spencer; the Anatomy of Melancholy of Robert Bur-

ton, and all the works of Francis Bacon into a political history of the times of Queen Elizabeth and that this volume now published is introductory thereto. He claims to do this according to a system called the secret cipher which is concealed in the above-named works, but he does not yet tell us how to work the cipher, so that we are not able to verify any of his work. In the opinion of several prominent literary and scientific men of Washington whom we have consulted, we ought not to place confidence in the cipher stories at present, nor until Dr. Owen has seen fit to allow us to pass judgment upon his methods, or until some one else has given us the workings of the keys.

This volume opens with "Sir Francis Bacon's Letter to the Decipherer," in which we are told something regarding the construction of the cipher but not enough so that any one except Owen has yet done any translating. A writer of this notice has spent some 50 or 60 hours in an effort to understand it but without success.

Our world has accepted much "history" upon the dictum of the historian and may perhaps accept the declaration that Francis Bacon was the son of Elizabeth, wrote all of Shakespeare, killed Shakespeare, bribed Spencer to father the Fairy Queen, knew Elizabeth to have been murdered by Robert Cecil, announced the circulation of the blood in 1612, (four year's before Shakespeare died) while Burton made it public in 1619,—the world may accept all this and much more that Owen has in store, but we, as scientists, apply the scientific method which requires all discoverers to submit for our repetition all the steps of their processes before we assent to their claims. No dark corners for us! If Owen has confidence in his cipher, why not publish it? Because he fears some one would use it and publish the secret history ahead of him and deprive him of the money to be made thereby. If he confesses to a money motive, the same motive may account for the book before us as an invention of Dr. Owen's. The 8 years which he says he has largely devoted to Shakespeare ought to have fitted him for such a task. But we intimate no belief; we merely suspend judgment until put in possession of the secret methods of the cipher.

G. W. Rafter, one of our valued contributors, has recently written a book on Sewage Disposal which has been published by Van Nostrand. We have not yet seen a copy.

THE MICROSCOPE.

Contents for May, 1894.

THE MICROSCOPICAL JOURNAL.

Contents for May, 1894.

BACK NUMBERS WANTED.

There are several Libraries and subscribers who have written for back numbers of THE MICROSCOPE which are exhausted. For any five of the following, we will give a year,s subscription :

1887, Nov., Dec. 1888, Feb., Mar., Apr., May, Dec. 1889, Jan. 1890, Jan., Feb., June. 1891, Jan., July, Aug., Nov. 1892, April.

THE MICROSCOPE.

JUNE, 1894.

NUMBER 18. NEW SERIES.

Objects Seen Under the Microscope.

XIII.—SECTION OF STEM OF SPRUCE.

(Pen Drawing,)

One of the premium slides prepared by Mr. Sutton, of Philadelphia, is the spruce stem shown in cross-sec-

tion above. It will be interesting to study this in connection with the sections shown in the February number, pp 17-21, and to notice the difference in the struc-

ture of the wood, bark, rays, &c. We will make a present of the slide of spruce to each person sending in an article upon the differences between these four sections. Those articles which are worthy of publication will appear in a subsequent issue of this periodical.

Bacteriological Work in Medical Science.

By J. CHRISTIAN BAY,
DES MOINES, IOWA.

Until the middle of this century, medical science was in want of an explanation of the nature and origin of infectious diseases. The discoveries of Jenner did not have the background that they have now, and it was not until the year 1856, that the first microscopically controlled innoculations were made by Delafond, namely with anthrax. In 1848, the typical germ of this disease had been described by the same savant. Muchlhæuser (1845,) and Leisering (1860,) were the pioneers on the subject of typhoid fever, in the same direction.

Infectious diseases are manifested by a series of alternate phenomena which distinguish them from all intoxications. They are, as a general rule, caused by specific organisms (bacteria,) such as tuberculosis, malaria, typhoid fever, recurrens, cholera, yellow fever, etc., and many similiar diseases of animals are manifestations of their life and activity. When not attacking man or animal, they live in organic matter of various kinds; it is only when circumstances favor their activities that they will attack other organisms. It has been proved that many bacteria produce very poisonous substances. The body has to fight the attack made by these, and medicine can do but little to help the patient. Outside of the body, bacteria are found living in almost every place in nature where animals can live, and it is impossible to avoid coming into contact with them. In all rotten substance, in earth and water, in our clothes and

in our food, bacteria live, feed and thrive, and thus we are unable to avoid them.

The work of the bacteriologist consists in gathering full evidence in regard to the specific organism connected with a certain disease. In the first stages of many diseases—such as pneumonia and tuberculosis, it is of importance to know whether a typical bacterium of the fatal disease is present or not, and in what quantity. This cannot be determined with full evidence by the pathologic diagnosis alone ; when it is united with the bacteriological investigation, certainty may be reached, as sufficient morphological, physiolcgical, and biological characters of many of the typical forms are known in detail, so that comparing is possible. As the disease proceeds, it is often necessary to follow the development of the case. Therefore, the bacteriologist should work hand in hand with the physician.

Bacteriological investigations of air and water in towns or smaller localities (wells, sewers, etc.,) are important, and should be carried out at regular intervals so that the danger of contamination may always be checked. A great number of pathogenic forms will keep alive or actually live in water for a long time; they will come into the wells from the rottening or otherwise contaminated substances in the ground, etc., and attack the organism either by direct introduction into the body or be transmitted through the air from the surface of the water. It is always important to have an estimate of the bacteria living or able to develop in the water from which we are supplied.

Of almost equal importance are researches on bacteria in the atmosphere. The latter is in very many cases the way of transmission, and important results have been derived from such investigations.

Bacteriological analyses of the ground in certain districts are of importance in and after epidemics; such

places as are exposed to infection or already infected should always be examined. The results of such analyses have often given good information with regard to disinfection, and the life-history of many pathogenic forms have been made known.

In many cases, milk and other victuals will be subjects of investigation. Experience often shows that milk can transfer many infectious diseases, and that many pathogenic forms of bacteria keep alive in milk. Meat should be subject to constant control, as is, in fact, the case in some countries. Many other articles of our daily food should likewise be examined. It is not untimely precaution or falling into the "bacteria rage" of our age to urge the necessity of controlling grocery stores as well as meat markets. Another place where bacteriological control is necessary, is in the treatment of many drugs.

The question of disinfection is based entirely upon bacteriology.

It is very evident that, though the importance of bacteriology has been and still is often over estimated, it cannot be lost sight of when we know how public health must depend upon its many important results. Almost every day discloses new facts or theories, and there is hardly any department of science in which it is so difficult to follow the progress as just here. But the medical bacteriologist cannot work alone if his work is to bring out hygienic results; he must work hand in hand with the chemist. The combined results of the chemical and the bacteriological water-analysis form the complete hygienic investigation of the water. But, more than this, everybody should receive such information as this, and learn the necessity of disinfective hygiene in public and private life.

The methods of bacteriological work are somewhat different from the work otherwise performed by the physi-

ologist, inasmuch as the bacteriologist must be acquainted with certain important chapters of vegetable physiology. But they are by no means always simple, and they require the same amount of patience that is expected from the man who carries out difficult physiological experiments. First of all, a laboratory with facilities for cultivating and experimenting with the many different forms which come under observation, is necessary. Here the species are determined and experimented with, analyses are made, and first-hand information is obtained. Next to this, comes a suitable chemical laboratory, apparatus for photographing, etc. None of these things are very expensive, and, if once obtained, retain their value.

Protococcus and How to Mount them.

By ARTHUR M. EDWARDS, M. D.,

NEWARK, N. J.

Red snow, which I have been looking at lately, though one of the first organisms I studied, now nearly forty years ago, I recently reported on in the *Microscopical Journal* and this brought me to raking up what was known on that subject. It also led to my gathering what was published on the Protococcus, that common green slime on marshes and on walls and fences everewhere. I thought that a resume of the researches would be profitable and therefore put them down. I also made some experiments on mounting the Protococcus which is rather a difficult thing to do. For they do not possess any solid wall like my friends the Bacillariaceæ being made up of protoplasm, the most destructable thing we have to make permanent mounts of. But I think I have at last succeeded in mastering the problem and mastering the Protococcus by killing the thing.

For it cannot truthfully be said to be a plant, and it will not be said to be an animal, although the earlier ob-

servers, and some of the later too for the matter of that, called it an animal. It was so lively, swimming about with a vigor that was truly amusing. In time, as plants were studied, their spores were seen to be lively also, and Protococcus was transferred to the vegetable kingdom. For a long time it was bandied about from one kingdom to the other resting nowhere, until it dropped into the catagory of Protista of Hæckel. But this was not permitted to rest easy for it was discovered that many things would be classed as Protococcus and at present we are left in doubt where to place it. If I may be permitted to state what I think are the facts, the Protococcus may stand in a place where they may be plants at one time and animals at another; that is to say, elements of spontaneous generations. For I think it can be demonstrated that they generate without any eggs out of carbonic acid, and ammonia. I know this will be considered heterodox by the older students, but the modern students, who are searchers after truth, will I am sure, bear me out.

If we gather by scraping, by means of a knife, some of the green coating that is on the bark of trees or on stones or on brick buildings and place it in water and examine it by means of a quarter inch lens and a one inch occular, we find a number of spheres or green substance surrounded by a transparent stiff cell wall. When we have a typical Protococcus among the green cells or spheres we will see some begining of cell division. And when we look further we will have some sproutings of what seemed to be algæ, of two or more cells joined end to end with the cells themselves more or less elongated. These latter will not seem to bear any relation to the Protococcus itself, but appear to be algæ. Such was the interpretation of the older observers. But they were mistaken. The spheres are the young of the growing plant and the elongated seeming algæ are the midway

stages of mosses. We can keep this in water and watch it grow, but as it is in water it will never grow into a moss. It wants to be kept out of the sun and just moist, so that we can see it grow into a red stage, wherein the cell contents become red colored. But in this, it must be in the sun and kept in water. Besides it must be kept cold. In winter such a stage is seen and it goes by the name of Red Snow then.

Let us now collect some of the green slime that is so common on the surface of the water of both fresh water and brackish swamps, and examine it by means of the microscope in the same way. We shall find it to be composed of a mass of green things which we find to be individuals of a totally different character. Instead of being at rest we shall find it extremely lively; shooting about in various ways are spheres and various shaped organisms with a point in them of a light crimson elongated, and with a cell-wall thin, but not so thick of white as the Protococcus we have before seen and more visible and not stiff as that. As they swim about they will be seen to advance in the following manner. The front portion will swell and the swelling will pass down across the length of the creature without the creature itself advancing as quickly until the swelled part disappears and is lost or passes off at the end. Another swelling will appear on the advanced end and pass off in the same manner. Another and another will appear and disappear, and this takes place without the organism moving onward at all. Now the organism will move with a revolving motion, slower than the appearance of the swellings. If we look at the organism closely, we will see a bright red spot at one end, the end that advances, looking like an eye. In fact this was concluded to be an eye, and the whole organism itself was thought to be an animal, and was called Euglena, whih is now known to be an organisms--neither animal nor vegetable, but Protista.

So much for the Protococcus; and now how to preserve them for future reference. When examined chemically they are found to be made up of protoplasm colored with green coloring matter. No siliceous or woody tissue is present so that the microscopist is puzzled to fix them and to have a medium which will preserve them intact. For years I have tried various ways of mounting them and even neglected the mounting in carbolic acid for that was unreliable. I think now that I have got a way for mounting Protococcus and even animalcules which are transparent and formed of protoplasm alone. These latter, it is known, must hitherto be studied alive for they cannot be preserved, or at least could not until I tried the process I am about to describe. But I do not claim the process as applicable to animals. I only say that I think they will do with it.

To describe: I take the Protococcus and kill it by a saturated solution of Salicylic acid. This will kill anything be it vegetable or animal or Protista. Then washing the acid with water, I introduce a weak solution of ammonia (household ammonia); to this is added a few drops of a solution of Gum Thus in alcohol, or wood spirit and it is permitted to stand for a day in an uncovered vessel. The ammonia will go off, and likewise the alcohol, in a great degree. We have then a solution of Gum Thus in water. This is evaporated down at the ordinary temperature of the house, 60° F. until we have the Protococcus in a strong solution of Gum Thus. More Gum Thus is added and mounted in the usual manner in which Canada Balsam is used. We have now Protococcus mounted in Gum Thus which is of good color and refractive index, showing the organisms nicely. I have tried this mode with Bacillariaceæ (Diatomaceæ) and found it all that can be wished for. Vegetable and animal tissues can be mounted in it also and I think that we have in it just the medium we wanted.

Models for Constitution and By-Laws of a Microscopical Society.—IV.

[In 1893 there were presented the Constitutions of the Washington and San Francisco Societies, pp. 69, 133. Others are desired for use in this series.—EDITOR.]

CONSTITUTION OF THE LINCOLN MICROSCOPE CLUB, NEBR.

Article I. The name of this organization shall be THE LINCOLN MICROSCOPE CLUB. Its objects shall be the promotion of interest in the microscope and the encouragement of microscopical research.

Article II. Any person, a resident of the city of Lincoln, may become a member of the club upon written recommendation of two or more members and election by a majority of the members of the club present at the regular meeting next after the meeting at which such recommendation is presented. Honorary members may also be elected by the club on nomination by the executive committee.

Article III. The officers of the club shall be a President, a Vice-President, a Secretary, and a Treasurer, who shall hold their office for one year or until their successors are elected. The President and Vice-President, shall be ineligible for re-election for one year after the expiration of their terms of office.

Article IV. The duties of the officers shall be the same as in other similar organizations. But it shall also be the duty of the President to deliver an address at the meeting next after his election.

Article V. The executive committee shall consist of the President and two members of the club to be elected for one year. It shall be the duty of this committee to appoint the place and provide for the program of the regular meetings of the club and to manage its general affairs. This committee shall also have power to call special meetings for the transaction of necessary business

upon reasonable notice in writing to the members of the club.

Article VI. The election of officers and members of the executive committee shall be held on the fourth Tuesday of January in each year. Their terms of office shall commence at the close of the meeting at which they are elected.

Article VII. The initiation fee shall be one dollar, in addition to which there shall be each year thereafter an assessment of one dollar payable in advance. The name of any member two years in arrears for annual assessment shall be dropped from the list of members and shall not be restored until all arrearages be paid or until there be a re-election.

Article VIII. The regular meetings of the club shall be held monthly at a time to be designated by the club.

Article IX. Amendments to this constitution proposed in writing at any regular meeting, may be adopted by a two thirds vote of the members present at the next regular meeting. But the club may at any regular meeting establish By Laws or other Rules not inconsistent with this constitution.

Rules.

1. The President shall call the meeting to order promptly at 8 o'clock P. M., for a short business session.
2. The order of business shall be as follows:
   a) Reading of minutes.
   b) Reports of committees.
   c) Motions, resolutions, and general business.
   d) Roll-call.
3. At roll-call each member shall make a brief statement (not to exceed five minutes) in general explanation of the specimens or apparatus he has on exhibition, or he may make a brief oral or written communication (not to exceed five minutes) upon an appropriate topic.

4. The executive committee may provide for occasional formal papers and addresses, or longer communications, from members or others, and the titles of them are in all cases to be previously placed on the program on the blackboard, with the time (approximately) to be occupied.

5. After the roll-call and the papers, if any, the remainder of the session shall be informal, each member examining the specimens and apparatus in which he may be most interested. In this part of the session no "order" shall be observed or maintained.

6. At 10 o'clock the President shall declare the meeting adjourned.

Our Instrument in the study of Natural History.--The report of the recent Conference on Natural History rendered to the Committee on Secondary Studies of the N. E. A., constantly emphasizes the use of the microscope. See

Page 151 (among the necessities for proper Botanical work). "Table room, a good compound microscope magnifying from at least 50 to 300 diameters, and a few ordinary re-agents should be furnished each pupil."

Page 161 (Physiology). "Demonstrations of the histological structure of the various organs require the use of a good microscope, with powers of four or five hundred diameters. It will add greatly to the interest if the teacher is able to make a portion, at least, of such preparations in the presence of the class. If the possession of a number of microscopes renders it possible, it is very desirable that an opportunity be afforded students for making for themselves preparations."

Page 154 (Zoology). "The microscope may well be employed in calling attention to the structure of the scales (of the fish). No better object will ever be found for exciting interest among young naturalists than these scales exhibited by polarized light."

Centrifugation—to separate sediment, is coming into general use among European investigators. A number of instruments are in use for the purpose.

THE MICROSCOPE.

New Series, 1893.

For Naturalists, Physicians, and Druggists, and Designed to Popularize Microscopy.

Published monthly. Price $1.00 per annum. Subscriptions should end with the year. The old series, consisting of 12 volumes (1881–1892), ended with December, 1892. Sets of the old series cannot be furnished. All correspondence, exchanges, and books for notice should be addressed to the Microscopical Publishing Co., Washington, D. C., U. S. A.

CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

The Antwerp Exhibition.—The best exhibits of microscopes are by English firms, notably W. Watson & Sons. They show the Van Heurk microscopes which are admirable for scientific research. The lenses are fine and all the parts adjustable with ease and accuracy. They also show slips, mounts, etc., as well as photographic apparatus.

Aluminium.—Its weight is $\frac{1}{3}$ that of iron, $\frac{1}{4}$ that of silver, $\frac{1}{8}$ that of gold. A gun metal casting weighing 53 pounds could be cast in aluminium with only 16 pounds. It is very maleable and can be rolled like gold or silver. It conducts heat and electricity readily. It is not corroded by moisture, sulphur, vinegar, or dilute acids. It is too soft to stand much wear or strain. For use in microscopes it is alloyed with nickel, copper, tin, silver, etc. The oldest aluminium works are only 35 years old. In nature, this metal is very widely distributed. The aluminium bronzes are among the very best as they resist oxidisation, are unaffected by sea water or by ammonia.

A New Biological Microscope.—Messrs. Swift & Son have made an instrument with the posterior limb of the tripod doubled and rotating on a pivot. This gives increased steadiness to the stand and the instrument can be packed in a smaller case. The pivot has a strong spiral spring which prevents it becoming loose and takes up any wear on the bearing surfaces.

QUESTIONS ANSWERED.

NOTE.—*Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of al. grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.*

192.—*What is a "spot lens"?*—S.

Carpenter say a spot lens is a condenser with a permanent axial stop fixed in it to cut off the central rays for the purpose of obtaining a dark ground upon which the illuminated object lies. Obviously it is not a desirable accessory. It is a condenser, but having a fixed stop it can only be used for this mode of illumination.

193.—*How many specimen slides for the microscope would be requisite to a complete study of human anatomy?—Science Siftings.*

A *complete* series of mounts showing all the structures and elements of the body, would number many hundreds. A series of about 100 preparations if well selected, would show all the typical and important tissues. Many of the sections would show several sorts of tissues for instance, transverse section of trachea would show hyaline cartilage, involuntary muscle, mucous glands, capillaries and ciliated epitheleum. A section of scalp would show, epidermis and its epitheleum, hair root and sheath, sebaceous and sweat glands, adipose, areolar and elastic tissues. One section each, of kidney, liver, lung, ovary, testis, etc., would show typical structure and enable one to identify the organ, but a *complete* demonstration of all the elements involved, would require dozens of preparations for each organ. About 300 varieties of elements and tissues are studied in a good course in histology.

PRACTICAL SUGGESTIONS.

By L. A. WILLSON,

CLEVELAND, OHIO.

Foramenifera.—As we cannot conveniently take a stroll to Iceland to collect specimens, we may do it indirectly by entering any drug store, and obtaining a little paper full of the sand that comes in the packages with Iceland moss. This sand is

frequently crowded with foramenifera. A specimen which I examined was full of a species of porcelanous foramenifera. They varied from the size of half a pin head to that of a pea. They were easily picked out of the sand with a moistened needle point or a delicate pair of forceps. Beautiful mounts suitable for a two inch objective can be made of them by mounting on a dark back-ground.

Circulation of Blood in a Lizard and a Tadpole.—Noticing in a glass of water a little lizard about as long as a pin, I removed it to a slide with a ledge. The little animal was very active and would have jumped off the slide had care not been taken to prevent its escape. It soon adhered quite closely to the slide. A drop of water was placed on its head and it was viewed with a one inch objective. In the toes and end of the tail the circulation of the blood was beautifully displayed.

The same thing may be observed in the tail of a tadpole. There is a transparent expansion of tissue on each side of the dark central line of the tail. Place the animal in a cell, keep its head moistened with water and view with a one inch objective. The blood may then be seen coursing through the veins and arteries.

The methods here indicated dispense with frog plates and other cumbersome appliances.

An Easy Method of Examining Lichens.—Soak the lichens in water, then remove one of the apothecia to a slide. Immerse it in a drop of liquor potassa. This liquor dissolves and softens the hymenial gelatine and renders the hymenium more easily separable. Then crush and tease the specimen with a spatula. Remove the larger masses of debris; place a thin cover on the slide and examine with a quarter inch objective. In this way the lichen may be analyzed. There is a little work entitled " An introduction to the study of lichens " by Henry Willey, which will enable the student to trace the specimen to its genus.

For more advanced work the " Genera Lichenum " by Dr. Edward Tuckerman will be found useful. The specimen may be rendered more distinct by a solution of iodine of which the formula is iodine, one grain; iodide of potassium, three grain; and pure water, one ounce. The effect of iodine is to color the

hymenium, and sometimes the spores, blue violet or various shades of red. The medullary layer of lichens is often colored blue by iodine. The plants will well repay the study and instead of being very simple they will be found to be very complicated plants. They belong to the Carposporæ and partake of the nature of both fungi and algæ.

After soaking the apothecium in water instead of crushing and teasing, fill the cup with potassium hydrate. Then with a spatula scrape the inside and place a small portion on a slide. In this way the hymenium will frequently be removed intact and will display the theke, paraphyses and spores.

RECENT PUBLICATIONS.

The Journal of Marine Zoology and Microscopy. Vol. 1, No. 1. Nov. 1893.

This is a biological quarterly dealing with the fauna of British seas; and contains many interesting facts and accurate descriptions, in plain wording and accompanied by original illustrations. Personal observations upon the habits of marine animals, together with notes and short articles upon the numberless problems of shore and ocean life, form leading features. The endeavour is to avoid the technical language too frequently met with in Zoological writings, as well as to keep the pages free from trivialities and thread-bare expositions of text book matter.

The Microscopical section consist of "Studies" which deal in pleasant but *exact* manner with the anatomy, life-history and habits of noteworthy microscopical animals. In this way are treated the Protozoa, the spicular Sponges, the young stages of Zoophytes, Worms, Crustaceans and Ascidians. Thus the studies form a series of most interesting articles of great value, as many of the facts are original, and of a nature not to be met with in ordinary text books.

Two full-page lithographed plates, sketched from life, and of first class execution, are, in each number, devoted to the *original* illustration of the microscopical Marine life treated of in the "Studies." To add to the value of these illustrations, they are often coloured. To ensure accuracy, this is done by hand. There are also reviews, the record of Zoological progress, hints on Microscopical mounting, Exchanges, &c.

THE MICROSCOPE.

Contents for June, 1894.

THE MICROSCOPICAL JOURNAL.

Contents for May, 1894.

BACK NUMBERS WANTED.

There are several Libraries and subscribers who have written for back numbers of THE MICROSCOPE which are exhausted. For any five of the following, we will give a year's subscription :

1887, Nov., Dec. 1888, Feb., Mar., Apr., May, Dec. 1889, Jan. 1890, Jan., Feb., June. 1891, Jan., July, Aug., Nov. 1892, April.

THE MICROSCOPE.

JULY, 1894.

NUMBER 19. NEW SERIES.

Objects Seen Under the Microscope.

XIV.—SOME NEW DESMIDS.

[Pen Drawings.]

The forms shown in the accompanying illustration are mostly new, either as species or as varieties and have been described by W. Barwell Turner, of Leeds, in the *Naturalist*. The group well illustrates to the casual

1 10 2 10 8 19 20 3 9 4 13 12 21 11 18
17
14
5 15, 15 6 7 16

reader what we mean by desmids, and for students of such forms it is simply designed for a clue to call their attention to Mr. Turner's longer article. The names of the species are, however, appended for the information of those who possess Wolle's or some other treatise on

the desmidiaceæ. For elementary knowledge on these beautiful plants, see Carpenter on the Microscope.

1. Euastrum cambrense.
2. Euastrum snowdoniense.
3. Euastrum binale.
4. Euastrum webbianum f. major.
5. Euastrum crassicolle ?
6. Euastrum anglicanum.
7. Cosmarium gotlandicum v. cambrense.
8. Staurastrum lewisianum.
9. Staurastrum westii.
10. Staurastrum diplacanthum v. anglicum.
11. Staurastrum eboracense.
12. Staurastrum trelleckense.
13. Micrasterias papillifera v. varvicensis.
14. Micrasterias truncata.
15. Penium lewisii.
16. Docidium hutchinsonii.
17. Closterium intermedium v. sculptum.
18. Cylindrocystis roseola.
19. Spondylosium monile.
20. Spondylosium armillatum.
21. Eurastrum exile.

The Microscope in the Dairy.

By PROF. H. W. CONN,
WESLEYAN UNIVERSITY.

The great service that the microscope has been to the brewing and vinting industries in the hands of Pasteur is well known. At the present time no brewery is equipped without its microscope and its microscopist for the purpose of studying its yeasts and obtaining the proper pure cultures of appropriate species for fementation. The great importance of this application of the microscope to the brewing industry is to-day hardly

appreciated because it has become so thoroughly a matter of course. A great brewery would be impossible if its fermentations were simply experiments liable to go wrong. It is not, therefore, too much to say that the gigantic breweries of to-day are possibilities only because the microscope makes their operations matters of absolute certainty.

A similar change seems to be surely coming over the dairying industries of the world, and in almost identically the same lines. We are rapidly learning that the manufacture of the high quality of the modern dairy products of butter and cheese is a matter dependent upon micro-organisms, and the production of a high grade of butter and cheese is just as truly dependent upon the use of proper bacteria species as is the production of a high quality of beer dependent upon the use of proper species of yeasts. During the last five or six years several bacteriologists have been undertaking the study of some of these problems and the question of the application of the microscope to butter making seems to be in a very fair way of immediate solution though its application to cheese making has not yet progressed so far. The work upon this subject has been carried on chiefly by Prof. Storch, of Copenhagen, Prof. Weigmann, of Kiel, Prof. Adametz, of Vienna, and in the laboratory of Wesleyan University in this country, by the author. These experiments have been slowly solving problems in butter making which have proved much more difficult than those associated with brewing.

It is an almost universal custom to allow cream to "sour" or "ripen" for some time before it is churned. It has appeared first that the flavor of butter is due almost entirely to certain volatile products making their appearance in the cream during this process of ripening or souring, butter made from cream without such ripening being very tasteless. Further it has appeared

that these volatile products are due to chemical changes taking place in the cream as the result of the active growth of micro-organisms present in it. The chemical side to these changes is at present very little understood, but that the flavor of the butter is due to the products of fermentation is beyond question. It has also appeared that different species of bacteria vary widely in the character of the products which they produce in the ripening cream. Some species will give rise to those exquisitely delicate flavors which are desired in the highest quality of butter, while others give rise to flavors and tastes which are extremely disagreable, producing butter of the very poorest quality and one that would hardly sell in market at any price. Other species again produce changes in the cream which have little or no effect upon the flavor of the butter. Now it is, of course, plain that to manufacture a prôper high quality of butter, the buttermaker needs in his cream for the ripening a majority of the best class of bacteria, and it is a matter of as much importance to him to be able to control this factor as it is to the brewer to obtain pure cultures of yeasts for fermenting his malt.

As butter has been made in past years, however, the butter maker has no means of such control. The bacteria that are present in the milk find entrance thereto from a variety of sources in the barn and the dairy, and the buttermaker has no knowledge as to what sources may be depended upon to give him proper species, or what ones to give him those that he wishes to avoid. When the cream is gathered from a variety of sources and mixed together in a large vat for ripening, as in creameries, it is largely a matter of lottery as to whether the cream will contain species that are likely to produce a properly flavored butter or those which will ruin the product. Indeed the buttermaker knows nothing about the subject, and simply allows his cream to ripen under

the miscellaneous collection of bacteria which chance to be furnished him from the various sources from which the cream is obtained. Now if it chances that the proper species of bacteria are present in sufficient quantity, the resulting butter will be of a proper quality, but if, as is frequently the case, improper species of bacteria are present in greater number and the proper species in only small quantity, the resulting butter will be of a poor quality in spite of every attempt made on the part of the buttermaker to improve it.

As our butter is each year being made more and more largely in central stations or creameries, this impossibility of controlling the ripening process becomes a more and more serious matter, and creameries producing several hundred pounds of butter per day are largely handicapped by the presence of improper species of bacteria in the cream. In spite of every precaution taken on the part of the buttermaker or the creamery superintendent, such species cannot be avoided and give a poor quality to the whole creamery product. Difficulties from this source do occur occasionally in the very best creameries, and very commonly occur in creameries that do not pay the strictest attention to the condition of the patronizing dairies. If butter making is to be still further concentrated and produced in creameries in still greater proportion, the desirability of controlling the ripening process becomes greater and greater.

Now as the result of bacteriological experiments a solution of this problem appears to be close at hand. It is theoretically only necessary to find and cultivate the proper species of bacteria and to furnish such cultures to the creameries for artificially inoculating their cream in order to produce a uniform good product. Of course many difficulities arise in the way of the practical application of such methods. The work upon bacteria is much more difficult than the work upon yeasts, and it

proves a matter of much more difficulty to isolate and cultivate the proper species of bacteria for butter ripening than to produce pure yeasts. Still this has been done by at least three of the experimenters above mentioned. Prof. Storch, Prof. Weigmann and the author of this article, have each succeeded in isolating from ripening cream species of bacteria which produce a high quality of butter where used in laboratory experiments. The introduction of these experiments into creameries presents special difficulties and yet difficulties that are being rapidly overcome. Already creameries in the vicinity of the laboratories of the above mentioned experimenters have been furnished with pure cultures of bacteria for the purpose of improving the butter product. The success of the experiments has been marked in each case. In Denmark it is getting to be more or less common to use an artificial ferment for cream ripening. The same is true in certain regions of Germany. In this country the work is more recent, but several creameries have undertaken the use of pure bacteria cultures for ripening cream and with universal success. Wherever the artificial ferment has been used there has been found an immediate and quite noticeable improvement in the character of the butter, and creameries that have once used this method are so pleased with it as to desire to keep it up indefinitely, for they find not only a better butter results, but a much greater uniformity in the quality.

An interesting fact in connection with these experiments is that the species of bacteria used for this purpose by the different experimenters do not appear to be the same or to have any special relation to each other. Cultures used in some places are those producing lactic acid, souring the milk and cream rapidly, while in other localities the cultures that produce good results do not give rise to any considerable quantity of lactic acid and

do not sour the milk or cream. This, of course, indicates that it is possible to obtain a proper result by the use of a large variety of bacteria cultures, and that the peculiar aroma of a good quality of butter is a general decomposition product and not one due to any specific bacteria species. It is also a matter of interest that it is not found necessary to destroy all of the bacteria present in the cream before the addition of the artificial ferment. In many of the experiments, indeed in a majority of those in large creameries, it has only been found necessary to add to the cream ready for ripening a large quantity of the artificial culture, and the large quantity added will find the conditions in the cream such that they can grow rapidly enough to entirely outweigh the effects produced by the slower growth of other species that may be present. Consequently in the experiments in our creameries it has only been found necessary to collect the cream and then to add a considerably large quantity of an artificial ferment thereto and the proper result is obtained at once.

Of course this work is wholly new, but the success that has attended the experiments where they have been tried is so great as to give us almost certainty that a few years further will see in the dairy industry a new application of the microscope to practical life. The manufacture of these artificial ferments will some day be a commercial industry, and is an operation involving more or less use of the microscope. The discovery of the ferments and their action upon dairy products is, of course, wholly due to modern microscopical methods, and thus we find here a new and entirely unexpected use of the modern microscope.

Potassium permanganate is a newly discovered antidote to potassium cyanide. Administer one-half litre of a three to five per cent solution internally.

How I Got Tourmaline for my Microscope.

By HANS M. WILDER,

Philadelphia, Pa.

I went to the "only" Foote and got a lump (small one) of rather light colored (quite colorless) Tourmaline for about twenty cents, and proceeded forthwith to reduce it to a "film;" easily thought, but unmindful of my musty mineralogy, I put a sharp knife, fortified with a smart blow with a hammer, on to one side of the lump, hoping to cleve it somehow. As was to be expected, I merely reduced it to fragments, luckily obtaining two "slivers" which I proceeded to grind down. I succeeded—at least my fingertips made me believe it—and found that the results worked farely well. Hence I argued, that a professional grinder (or petro-microscopist) would succeed, and that a price of, say, $1. to $1.50 would be fair for a small slip, say 1-6 or 1-4 inch square, which size is sufficient. The Tourmalines of microscopical dealers are quoted as high as $8. (See Beck.) Then I bethought myself of a pair of Tourmaline tongs which I had. I cut off one of the fittings, and fitted it in the lower part of a wooden ointment box, wide enough to slip easily over the eye piece.

From what I have observed, I think that the light brown ones are the best, and the slight alteration in the shade of the colors does not make any difference for amusement purposes, and hardly any for scientific investigations. "My" diaphragm is a good idea, the only trouble I have is that the condensing lens is rather unmanageable, as far as accurate focusing is concerned, but my idea can be improved upon. At any rate it gives greatly increased illumination—whether accompanied by the production of false images, is not for me to say—and up to ⅛ objective it is reliable enough.

Models for Constitution and By-Laws of Societies.---V.

CONSTITUTION OF THE OTTUMWA MICROSCOPICAL SOCIETY.

OTTUMWA, IOWA.

ARTICLE I.—NAME AND OBJECT.

This society shall be known as the Ottumwa Microscopical Society. Its object shall be the study of microscopy.

ARTICLE II.—OFFICERS.

The officers of this society shall be two: a President and a Secretary. The secretary shall also be treasurer. The officers shall be elected by ballot at the first regular meeting in September each year and shall hold office for one year or until their successors are elected.

ARTICLE III.—MEMBERSHIP.

The membership of this society shall consist of not more than ten active members and five honorary members. Each member must own or have free use of a microscope with one objective of at least one-sixth inch focus.

ARTICLE IV.—CONDITIONS FOR ADMISSION.

Applicants for membership shall present a written application accompanied by a thesis on some subject of interest to the society at a regular meeting. The application having been read shall be laid over until the next regular meeting when it shall be submitted to a vote of the society. Two members voting "no" shall be sufficient to prevent a person from becoming a member. Should one vote "no" the application shall be laid over until the next regular meeting when a second ballot shall be taken, a full vote of the society being necessary to elect.

ARTICLE V.—MEETINGS.

This society shall meet the second and fourth Tuesday evenings of each month and three members shall constitute a quorum.

ARTICLE VI.—AMENDMENTS.

This constitution may be amended at any regular meeting of the society by a two thirds vote, notice of such amendment being given at the last regular meeting.

THE MICROSCOPE.

New Series, 1893.

For Naturalists, Physicians, and Druggists, and Designed to Popularize Microscopy.

Published monthly. Price $1.00 per annum. Subscriptions should end with the year. The old series, consisting of 12 volumes (1881–1892), ended with December, 1892. Sets of the old series cannot be furnished. All correspondence, exchanges, and books for notice should be addressed to the Microscopical Publishing Co., Washington, D. C., U. S. A.

CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

Micro-organisms in Water.—This is the title of a volume just published in England at $4.00. The author is Percy Frankland, Ph. D. We have not seen the book, but notices in our European exchanges represent it as a standard work on the identification and removal of low forms of life from water supply. The author gives quite a treatise on bacteriology, including sterilization, media, staining, etc. The action of light upon bacteria is fully treated. In a 126-paged appendix are given descriptions of over 200 micro-organisms liable to be found in water, in the expectation that persons in charge of water supplies will be able to make their own identifications.

Fortunately we have at home an authority upon this subject, Mr. G. W. Rafter of Rochester, who has also published an exhaustive treatise on the same subject.

The duty of $1.00, which it costs to import Dr. Frankland's book is offset by a correspondingly high price put upon Mr. Rafter's book, so that both are out of the reach of common microscopists. Such is the tax put upon science by the monopolist's tariff bill which is now being passed by professed free traders, and by the McKinley law, now in force.

Opium.—Dr. P. Hehir, Surgeon Captain in the Bengal army (and one of our subscribers) has made an extended study of the opium habit. He estimates that there are 1,400,000 consumers in Hyderabad out of a population of 11,000,000. He says that

12 per cent of the Mohammedans, 7 per cent of the Hindus and 5 per cent of the Pariahs use it. Each devotee on the average consumes eight grains per day, four in the morning and four in the evening.

If used in moderation, it enables a person to do more work on less food and sleep than otherwise. For the time being, it gives him unusual cheerfulness and disposition to work, calms irritation, allays excitement, conquers resentment, quiets the nerves and emotions, lengthens life, diminishes the death rate, cures diabetes and never produces organic disease. Its chief evil is producing constipation. Indian opium is pure and contains but little morphine. Life Insurance Companies charge no extra premium on the lives of opium eaters in India.

QUESTIONS ANSWERED.

NOTE.—*Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of all grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.*

194.—*What is a linen-prover?*

It is a small magnifier used for determining the fineness or closeness of weaving in a linen fabric.

195.—*What is a Lucernal Microscope?*

It is a microscope in connection with which a lamp is employed as the source of illumination.

196.—*As a recreation for spare time, would a Swift or Crouch Histological microscope with 1 inch and 1-6 inch objectives at $30, or a Beck's "Star" Microscope with same objective, at $20, be the better? Is a rack and pinion coarse adjustment any great advantage over a sliding tube?—Juvenis.*

A Swift or Crouch Histological microscope should be preferred. A rack and pinion coarse adjustment is a great advantage in *inexpert* hands, and a great convenience in any case. It can be easily and precisely managed with one hand and there is much less danger of forcing the objective against the object. A sliding tube soon gets dirty and works stiffly, or it wears and slides too easily.

197.—*How may I hold sections of rock for grinding between glass plates, with emery, and how shall I separate and clean them?—Nevins.*

Cement the rock slices to the glass with hard balsam, using a gentle heat. After grinding and polishing, remove the balsam by soaking the glass and section in spirits of turpentine. Rock sections are very fragile and in some cases it is better to grind them on the slip which is to be used for the permanent mount, and not remove them, but wash away the debris with turpentine and a brush. When clean add fresh balsam and cover.

198.—*Please give a satisfactory process for separating and cleaning Foramenifera, etc., from chalk?—R. D. Nevins.*

Use a soft brush and water to rub down the chalk. Mix the material with water and allow the shells to fall to the bottom; or, if these heavier portions are broken or not valuable, secure the good portions while still suspended in the water, by pouring them into another vessel and letting them subside. Examine the deposit as well as the floating material at times, with the microscope, to determine their relative values. If the desired shells are rough or covered with granular matter, shake them in a test tube with four times their bulk of well cleaned, heavy, sharp, white sand (prepared by washing and settling as above.) After the shells are clean allow the sand to sink, which it will do before the lighter shells. Pour off the latter into another tube. Here the shells will sink before the lighter fluffy material, and by a careful timing and several repetitions of washings and settlings, the fluff may be poured away, and clean shells secured. But few perfect shells from a considerable mass of material should be expected.

199.—*What is meant by the standard tube length? I read of a ten inch, nine and a quarter, eight and a half and six inch lengths, and so on, and am confused when I wish to use objectives by different makers. A reader.*

The standard tube length for American objectives is ten inches, measured from the optical center of objective to the optical center of eye piece. Optical centers are difficult to locate, hence the clear directions by Mr. Spencer, to employ a tube length of 9¼ inches, measured from the shoulder against which the objective rests, to the eye surface of an inch ocular.

The B. & L. Opt. Co. uses a tube length of 8½ inches, their style of eye piece projects ¾ of an inch above the tube, making a total length of 9¼ inches. The objective in both cases completing the 10 inches. The short or continental tube may be measured as above, 6 4-10 inches from eye lens to shoulder for objective. This is the proper length for the usual French and German objective.

200.—*Please cite publications upon our Amœba, since Leidy's "Rhizopoda" was published.* *W. L. Poteat.*

See Am. Mo. Mic. Journal vol. X, pge 151; vol. XII, pge 153, vol. VIII, pge 234 for valuable information on Amœbas.

PRACTICAL SUGGESTIONS.

By L. A. WILLSON,
CLEVELAND, OHIO.

How to Examine Pollen.—To see the shape of pollen grains they should be examined without a cover or in a cell as the cover nearly always presses them out of shape and imparts an incorrect idea of their form.

In the common yellow dock, (Rumex crispus), if viewed under a cover, the grains appear round; but, if viewed with an inch objective, they are seen in their natural condition as cubes. An inch objective and a D eye piece is preferable to a quarter inch. The grains are best seen as opaque objects or by oblique illuminations, with a spot lens or a parabaloid.

Staining and Mounting Pollen.—A slide of assorted and stained pollen grains is instructive and attractive. Place the pollen in a small test tube and use any of the aniline dyes used for staining eggs at Easter time. The pollen must be placed into the staining solution while it is hot. It may then be dried on the slide and mounted in balsam. For examining fresh pollen or even for mounting pollen, castor oil is one of the best media. This medium clears the grains beautifully and shows their markings distinctly. The grains may also be stained by aniline colors dissolved in alcohol.

Paste Eels (Anguillulæ aceti).—Paste eels and vinegar eels have been determined to be of the same species but the

paste eels have grown fat by feeding on paste. For an amateur microscopist, the paste eels are preferable as they are larger and more readily examined with low powers. To obtain and keep a supply of paste eels boil a little flower and water to the consistency of the paste used by bookbinders and shoemakers.

It is then best to plant some eels in the paste either by pouring in some vinegar known to contain them or by adding a little paste in which they already swarm. Leave the vessel containing them open to the air and to prevent hardening beat it well together whenever it tends that way. To preserve them all the year, put a little water or vinegar to them if the paste grows dry, or supply other paste. Their continual motion will prevent any mouldiness of the paste. A one inch objective is sufficient to show them nicely.

CORRESPONDENCE.

To Begin With.—Get an instrument by any good maker and by all means let it have a rack-and-pinion coarse adjustment. I have known many to begin without one and never knew one to be contented without it. Get a one inch objective. It is all you want. A 1-6 inch objective would be practically useless to to you. I have given lessons to beginners for years and this is the outcome.—AJAX.

RECENT PUBLICATIONS.

The Journal of Marine Zoology and Microscopy. Vol. 1, No. 1 Nov. 1893.

This is a biological quarterly dealing with the fauna of British seas; and contains many interesting facts and accurate descriptions, in plain wording and accompanied by original illustrations. Personal observations upon the habits of marine animals, together with notes and short articles upon the numberless problems of shore and ocean life, form leading features. The endeavour is to avoid the technical language too frequently met with in Zoological writings, as well as to keep the pages free from trivialities and thread-bare expositions of text book matter.

The Microscopical section consist of "Studies" which deal in pleasant but *exact* manner with the anatomy, life-history and

habits of noteworthy microscopical animals. In this way are treated the Protozoa, the spicular Sponges, the young stages of Zoophytes, Worms, Crustaceans and Ascidians. Thus the studies form a series of most interesting articles of great value, as many of the facts are original, and of a nature not to be met with in ordinary text books.

Two full-page lithographed plates. sketched from life, and of first class execution, are, in each number, devoted to the *original* illustration of the microscopical Marine life treated of in the "Studies." To add to the value of these illustrations, they are often coloured. To ensure accuracy, this is done by hand. There are also reviews, the record of Zoological progress, hints on Microscopical mounting, Exchanges, &c.

The study of the Biology of Ferns by the Collodion Method. By G. F. Atkinson. 8° pp 134, New York, Macmillan & Co. Price $2.25.

To microscopists this book is of more interest than the ordinary treatise upon biology on account of its technique. It is a little unusual to exalt the technique to a mention in the title, but microscopists cannot complain. We can only congratulate the author upon the success obtained by this method as set forth in the book. The infiltration of prothallia without shrinkage was a great success. In Part II, are given methods for preparing collodion solutions, for cultivating spores, for killing, hardening, embedding and cutting into sections the various organs. All this is of great interest to the microscopist. Methods of staining might well have been added, but for some reason do not appear.

Three-fourths of the volume is descriptive of the development and anatomy of certain kinds of ferns and the original illustrations lend much interest to the narative. Chap. I deals with the gametophytes; Chap. II-VI, with the sporophytes. Chap. VII is on "substitutionary growths." A bibliography and an index close the treatise.

We congratulate Professor Atkinson upon having led his pupils through a happy course of study of the ferns and trust that this is not the last we shall hear of his studies in the realm of plant morphology. Let nomenclature go to the rear for a while and let us know all about the processes of vegetable life.

THE MICROSCOPE.

Contents for July, 1894.

BACK NUMBERS WANTED.

There are several Libraries and subscribers who have written for back numbers of THE MICROSCOPE which are exhausted. For any five of the following, we will give a year's subscription :

1887, Nov., Dec. 1888, Feb., Mar., Apr., May, Dec. 1889, Jan. 1890, Jan., Feb., June. 1891, Jan., July, Aug., Nov. 1892, April.

THE MICROSCOPE.

AUGUST, 1894.

NUMBER 20. NEW SERIES.

Objects Seen Under the Microscope.

XV.—Some Vegetable Sections.

[Pen Drawings.]

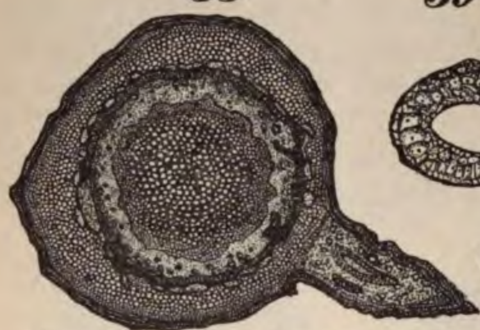
In order to give some idea of the botanical sections prepared by Walter White, an English chemist, and for sale by the publisher of this periodical, illustrations of three are given herewith. These sections are cut very thin indeed with a microtome, stained singly, to trebly as the case may demand, mounted on card board by

means of thin slips of mica and sold at the ridiculously low price of 8 cents each or 20 for a dollar. The price gives no adequate idea of their value. They would easily bring 25 cents each in this country if we asked it. But Mr. White cuts enormous numbers and sends them all over the world by mail as an aid to science. It is a

real benefaction to every student of microscopy, as appears from the eagerness with which they have been sought in this country the past six years.

Number 44 is a transverse section of a snowthistle stem and shows the collenchyma. This is a tissue of vegetable cells which are thickened at the angles and usually elongated. It is closely related to parenchyma, but has the cells more elongated. It can be found in the yellow dock and cow parsnip, in the petiole of the summer grape and of the begonia.

59



39

Number 59 is a transverse section of the one-year-old stem of Ivy. It shows the resin cells.

Number 39 is a transverse section of the anther of Crown Imperial.

A catalogue of all these objects can be found in the January number of THE MICROSCOPE for 1893, where there are also directions for mounting them upon glass slips when so desired.

Strasburger's Manual of Vegetable Histology, Prof. Bastin's College Botany, Carpenter on the Microscope and Behren's Guide to the Microscope in Botany are good books to use in studying these objects.

To Clean Balsam Mounts.—Use a strong solution of caustic potash. Apply with a brush.

A Quick Method of Cleaning Shells of Bacillariacæ.

By ARTHUR M. EDWARDS, M. D.,

NEWARK, N. J.

Since I first began studying the Bacillariacæ or Diatomaceæ, I have been puzzled to find a process for cleaning their shells in a manner that would be applicable to all the gatherings both recent and fossil. In the recent we have to deal with the organic matter that is present besides the siliceous shells. In the fossil gatherings we have to treat of the siliceous shells hid in a mass of clay more or less hardened. The recent gatherings are easy enough to clean. We burn only the organic matter off and the siliceous shells are left. With the fossil gatherings the case is different and more difficult to handle. The clay present in more or less quantity is not so easily removed. Besides it does not dissolve by ordinary methods. Let us see how we proceed in a quick manner, for I think I have at last hit that to clean the shells.

First, we have a recent gathering consisting of bacillarian shells and organic matter. We pour off the water first, and thus concentrate the shells. Then we pour them into a two ounce, wide-mouthed bottle. Such a bottle I have by me and constantly carry it to make my gatherings in. Into this I put a mass of finely pulverized bichromate of potash—enough, when it is dissolved, to leave some dry. This is enough, for the secret is to have enough. The bichromate is cheap enough, about twenty-five cents an ounce at retail, and an ounce will last for a long time. Now we wait for a few minutes until the bichromate is partially dissolved, and then add enough oil of vitriol (sulphuric acid) to super-saturate the water and cause the evolution of bubbles of carbonic dioxide, commonly known as carbonic acid. The action that goes on developes chromic acid, which is dark red, and this acts upon the organic matter and developes carbon dioxide. This action causes heat to be developed

and it can be carried on in the ordinary flat-mouthed bottle without danger of cracking it.

When it is in action the carbon dioxide is very little and no danger of poison is to be anticipated, for carbon dioxide (carbonic acid) must be in a vast majority in the air to be poisonous, and then its first action is to cause sleep. So, as I have said, there is no danger from poison in the process. While it is hot the bottle is placed out of doors, or at a window, so that the fumes which are going to be made by the addition of another liquid to it and which are poisonous may be carried off and not be inhaled, as that causes coughing. Hydrochloric acid (muratic acid of the shops) is added drop by drop. Immediately a brisk effervescence is developed, and bright red fumes are given off. These fumes are those that cause coughing. Enough hydrochloric acid is added to give off all the fumes, and, though the quantity can not be estimated, it is best to add enough, because the acid is cheap.

The bottle is permitted to stand about fifteen minutes, until the action has ceased, and then fresh filtered water is added in quantity. It is washed in filtered water three times, until it becomes light yellow in color. Then household ammonia is added (I use household ammonia, as it is cheap and strong enough), and it is washed with plenty of filtered water. I always use filtered fresh water for washing bacillarian shells, as I thereby obviate the chances of introducing foreign forms, since these can be introduced very readily, and the gathering is thereby ruined and made useless. This is the entire manner of cleaning recent fresh water shells. They can afterwards be kept in fresh water which has a little true salicylic acid added or oil of cinnamon. This will prevent the appearance of bacilli or of larger fungi.

With salt water recent gatherings of bacillariaceæ, the

process of cleaning is the same as that already described. The salt in the salt water only necessitates the using of a smaller quantity of hydrochloric acid.

When gatherings are made containing fine sand, as is commonly the case, it is rather difficult to concentrate them and separate the bacillarian shells from the sand, and in all cases we must expect to loose some of the bacillariaceæ. But I do not now intend to go into this branch of the subject.

Fossil deposits of bacillariaceæ are always made up of matter which contains clay in more or less quantity, and this modifies the mode of procedure in cleaning them in such a way that the shells may be eliminated, mounted and shown.

To begin with those containing a small amount of clay pulverulent and easily cleaned. The fresh water clay from Bowkerville, N. H., also known as Keene, N. H., is an example. This can be readily cleaned. It is only necessary first to boil it in weak aqua ammonia, add pulverized bichromatic of potash in excess, add oil of vitriol and hydrochloric acid. Clean with filtered water and add weak aqua ammonia and clean in filtered water. Next keep it in water to which salicylic acid or oil of cinnamon is added. In fact such a deposit is cleaned very much in the same manner as recent gatherings, the clay being removed by aqua ammonia, in which it is soluble. Sand is not present so that elutriation is unnecessary.

Next we have to deal with deposits like the fresh water indurated clay found near Virginia City, Nev., and which is known in commerce as electo-silicon. This is more difficult to clean, mainly on account of the large amount of clay present and the indurated character of it. This induration led me, at a former time, to class deposits of this character as volcanic being supposed to be formed in volcanic districts, and therefore as sub-

plutonic. But recent search has revealed these deposits, or some very like them, in districts which are non-volcanic, and they are not always sub-plutonic. But I will not now go into the cleaning of these nor of the marine fossil gatherings, such as those of Richmond, Va., and California, for this paper treats only of the quick method of cleaning the shells. It also records a method of cleaning without the use of nitric acid, which is always troublesome to use, being dangerous also both to the health and the clothes. In the method which I have detailed we have only carbon dioxide given off in small quantity, and the red fumes can be eliminated by the window or out of doors. The process is easy of use and yields very nice preparations.

The Origin of Fresh Water Clays in New Jersey, With Correlation of Clays in Other States.

By ARTHUR M. EDWARDS, M. D.
NEWARK, N. J.

I have been studying the fresh water clays in New Jersey for three years and this is the conclusion that I come to at present.

I have described in the Microscopic Notes nine deposits from the iceberg period, which includes fresh water, fossil, sub-peat and lacustrine sedimentary deposits of bacillariaceæ (diatomaceæ), as they were called when first discovered as lying in the lakes, or former lakes, in this country and Europe. They come from the Third river, or Yantacaw, to the Elizabeth river and neighboring streams in north-eastern New Jersey. The bacillariaceæ, sponge spicules and rhizopoda are the same, and grouped together differently but essentially the same. We have five kettle holes (and kettle holes are depressions of the surface mostly exactly circular without an opening and dry or with water in them), having

the same forms of bacillariaceæ in them. We have three deposits of peat; the forms of bacillariaceæ are immediately between the two, *i. e.*, iceberg period and kettle holes, but mostly resembling the first.

From this I gather that the whole country was covered by a fresh water sea formed by the melting of the ice after the icebergs were gone, and the water was cold. This sea came down from the northeast and threw down the clay which contains the bacillariaceæ, sponges and rhizopoda. Some of these are living now, as at Plainfield, and their decendants are the living forms that now people the brooks, lakes and rivers. And the bacillariaceæ, sponges and rhizopoda now are the decendants of those that lived in the iceberg period. As the water disappeared it left the rivers, the Rahway, Elizabeth, First, Second and Third and their tributaries, all opening into the Passaic river. There were on right bank the Saddle river, and above the Rockaway river on the left bank. I have not thoroughly investigated the Saddle, but think it was formed later than the iceberg period. The Rockaway river was formed in the iceberg period. The Passaic river was formed when the drainage of Lake Passaic, a pre-glacial lake, which in its turn was formed by the ice banking up above Patterson, and below by the mountains of the Watchung, and west the Granite mountains, which form the shores of the lake. This lake when the ice melted broke through the Watchung mountains at Patterson and formed the Great Falls there. The waters which formed it were extended to cover the Great swamp, Black meadows, Troy meadows, Great Peice meadows, and Bog and Fly meadows, and, lastly, Hatfield swamp, which was the last and lowest to form. In the clay of the Hatfield swamp are fresh water and some new marine forms of bacillariaceæ which lived then and are now living as shown by the water supply of Patterson containing them.

The Feldspar, on the northeast, when decomposed formed the clay and was mostly albite or soda feldspar with some orthoclase or potash feldspar, and the sand was quartz sand which is found now in the clay. This clay covered the country from Nova Scotia to the borders of New Jersey on the east of the Appalachian mountains. How far it goes west towards the Rocky mountains has not been determined but it is most likely the same.

The bacillariaceæ, or diatomaceous earths, which are known as fresh water, fossil, sub-peat or lacustrine sedimentary deposits, many of which I examined for the State Geological Survey of New Hampshire, under Prof. Charles H. Hitchcock, and the Northwest Boundary Surver for Mr. George Gibbs, and the State Geological Survey of California, under Prof. J. D. Whitney, are examples. How far to the west of the Appalachian mountains they extend I do not know, but two of them have been sent me by Mr. B. W. Thomas, of Chicago, and both are from the same iceberg period, containing precisely the same bacillariaceæ. These are between the first and second moraines of the western geologists; but we must say that Prof. G. H. Wright has endeavored to prove that there was but one glacial period and the two moraines were but one, formed at different parts of the same glacial period. I am disposed to side with Prof. Wright. The first that Mr. Thomas sent me was from Minnesota and was from Prof. N. H. Winchell, whilst the other was from near Chicago.

Typhoid Fever.

By ELMER LEE, A. M., M. D.

CHICAGO, ILLINOIS.

Recognition of the value of cleanliness represents the most practical discovery in treatment during the present generation, and, at the same time it constitutes one of the

really great discoveries in the history of medicine. The application of the principles of cleanliness more nearly meets the requirements of a real advance in curative medicine, than all the other propositions known to the profession for the cure of disease.

The symptoms of Typhoid Fever are too well-known by all to need particular mention; the question of burning interest is what to do to be saved. The disease is produced by drinking contaminated water, and its seat of development is situated in the intestinal canal. There is a poison there which, if it could be removed before it had become absorbed into the blood, life, and even health would be spared. Allowed to remain, the poison is drawn into the circulation, and very soon the whole body feels the depressing effect. Even at this time, if those remaining poisonous juices and germs which are contained in the bowels were either neutralized by suitable remedies, or washed entirely away by a stream of flowing water, the disease would be checked, the patient spared, and health restored.

Without waiting for development of the symptoms of Typhoid fever the very first proposition is to make thė patient surgically clean, which means the free and abundant use of water internally first, and externally afterwards. The bowels are drenched and cleaned by a copious douche of hot soapy water, made to pass into and out of the lower bowel, until the contents are cleared away and the returning water comes back as clear as before it entered. The relief to the sick person by following such ablution is a delight to the physician and of greatest comfort to the patient. It seems so reasonable, they will say, and in practice it is just as good as they say. Fears were formerly entertained by me, as they are to-day by some of my contemporaries, that something would be bursted by running a large volume of water into the bowels of persons sick with Typhoid

fever. No harm has ever been done, and neither is it likely to be so caused. Several hundred cases have been so deluged by me with large quantities of water, and in no instance has the result failed to be beneficial. The fear of doing harm may be entirely and forever dismissed. That which is not well understood by anyone, always seems inconvenient, or troublesome to perform. But a little practice makes easy the methods which a little while before appeared unpleasant, even hard.

The temperature of the water used for cleansing and washing the bowels, should always depend upon the temperature of the body. If there is high fever the water is more agreeable and useful to the patient when it is cool, viz.: 75 degrees; but if the patient is chilly, or has a low temperature, the water should be at blood heat, nearly 100 degrees. During the first week of illness, the irrigation of the bowels should occur in the morning and again in the evening of each day. After this, one douche of water should be given each day until convalescent. The co-operation of the patient is readily accorded. The treatment takes hold of his reason, which lends both hope and help to the management of the case.

Bathing the body is performed at regular intervals and by such a system as may be convenient and suitable to the individual. The bathtub may be used when the patient is strong enough to be assisted to it, where otherwise, sponging with cold water is very refreshing, and useful to maintain strength and lower the heat of the body.

The most effective and most lasting influence is secured by wrapping the patient in a wet sheet. Two blankets are spread on the bed, covered with a sheet wet with cold water. The patient is wrapped in the sheet, and then folded quickly and completely in the blankets. The time during which the sick one may remain in the wet pack is from one half to one hour, or even longer if

he is comfortable. Bathing opens the pores of the skin, and through them the system discharges a part of the hurtful wasts of the body. This bathing should be continued, several times daily, during the disease and during convalescence.

The internal treatment is uncomplicated, safe and useful. The basis of it is cold water, and always plenty of it to drink. Water cools the body and assists to cleanse it of the poison which makes it sick. The elimination is carried on through the intestinal canal, through the kidneys through the lungs and by the skin. Let the sick have water, it can do no harm in any case; water only does good. What cruelty it was in fever cases, to keep water from them, and what suffering it caused. A tablespoonful of Peroxide of Hydrogen (Marchand's) is added to each glass of water. It is the best and most simple remedy that can be given that is likely to be of benefit in helping to cure Typhoid fever. Continued for a few days, it is then laid aside for a few days and Glycozone substituted in its place, both as a relief to the patient and for the beneficial effect of the remedy itself. And so on in this way the two remedies are alternated, which is found by me to be the best arrangement for administering these valuable antiseptics. The preparation, Glycozone, is chemically pure, redistilled Glycerine in which Ozone, or concentrated Oxygen, has been incorporated, and can be taken with as much freedom and safety as pure Glycerine. The Glycozone may be taken in doses of half a tablespoonful to a glass of water as often as water is taken during the day. When it is desired to allay nervousness and induce sleep at night, sulphate of Codeine is used, in doses of from one half to one grain, by the mouth, or one quarter to one half grain by the hypodermic method. This remedy tranquilizes the nervous system and induces sleep, and should be administered at night.

The Typhoid fever patient receives as food, whatever is simple, at regular intervals of four hours. Milk, simple, natural milk, is nourishment of the highest importance. One egg every day, or every other day, is alternated with a small teacup of fresh pressed juice from broiled steak or mutton. The egg is pleasant to take and more nutritious, when whipped till it is light and then stirred with a small glass of milk. For a simple and nourishing artificial food, malted milk is always good.

The juices of fruits are delicious to the Typhoid fever patient, and are not to be dismissed on the supposition that they are injurious. It is always interesting to observe that, when the fever is broken, and convalescence is begining, water in copious draughts is no longer easy for the patient to take. When the usual glass of water is handed back half drained. it is an encouraging sign of beginning restoration. For wholesome drinking, fresh lake water which has passed through a Pasteur porcelain filter is entirely reliable.

The simplicity of the foregoing plan meets every requirement, and saves nearly every case, unless there is some complication. It is my belief that doing more than this is doing less, and less than this which is so simple, is not enough. The profession agrees that no kind of drug treatment is useful or curative in Typhoid fever, indeed, one of these days, in my opinion, the statment will be considered applicable to other, if not all, cases of diseases of the bowels.

The plan as proposed by me and practiced during a period of five years, consists, in review, of the following systematic management in Typhoid fever.

Water used internally as a douche for free irritation of the bowels, either simple or made soapy with pure liquid soap. Water as a drink, and as a remedy taken copiously and frequently, especially during the stage of

fever. Water is indispensable, and should be given as often as is desirable and agreeable to the circumstance of the case. Frequent application of cool water to the surface of the body during the entire illness.

Remedies: Peroxide of Hydrogen (Marchand's), or Glycozone, for the anticeptic effect of the oxygen which is set free in the stomach and intestines. But to be of real value, these remedies are to be taken in considerable quantity largely diluted in water, else, in my opinion, they are of little use. The capacity of the bowels is so great that a little of anything cannot spread over this enormous area to effect it beneficially. Cleanliness is the principle governing the use of Peroxide of Hydrogen (medicinal) and Glycozone.

For a remedy that sooths and brings on sleep at night, sulphate of Codeine is better than chloral, besides it is the safest and best.

For food, anything that is simple and in liquid form. Milk is always the best; milk and whipped eggs; pressed juice from broiled meat. The juice from fresh, ripe fruit. The nutrition taken should be at regular intervals (four hours), that sufficient time may be allowed for digestion.

Stimulants and drugs are injurious without exception, and better results are secured without their use. Typhoid fever, generally transmitted through the drinking water, is a preventable disease. Typhoid fever affects all classes, but if food and water were always pure, no class or age need contract Typhoid fever. Cleanliness everywhere and always is the means at hand which makes it possible to escape Typhoid fever and other diseases of the bowels. Internal cleanliness as well as external is a reasonable proposition of hope for the cure of the unhappy multitude of sick and discouraged humanity.

103 State Street.

NOTE.—The Pasteur system of water purification is suitable and reliable.

The one gallon red rubber fountain syringe, made by the India Rubber Comb Co., has been selected. It is thoroughly good.

Peroxide of Hydrogen (Marchand's) and the Glycozone are standard preparations.

Codeine is generally administered in tablets.

Liquid soap is adapted for medical uses.

Horlick's malted milk is a prepared food of merit.

THE MICROSCOPE.

New Series, 1893.

For Naturalists, Physicians, and Druggists, and Designed to Popularize Microscopy.

Published monthly. Price $1.00 per annum. Subscriptions should end with the year. The old series, consisting of 12 volumes (1881–1892), ended with December, 1892. Sets of the old series cannot be furnished. All correspondence, exchanges, and books for notice should be addressed to the Microscopical Publishing Co., Washington, D. C., U. S. A.

CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

Communion Cups Spread Disease.—The common goblet is a channel for the transmission of several serious and deadly diseases. The bacteria of tuberculosis, diptheria, and other contagions lodge in the mouth, and are transmitted to the wine by means of epithelium scales which drop from the lips of a communicant into a common goblet at the communion service. These scales float on the surface of the wine, unnoticed, and if a communicant is unfortunate enough to swallow one, the germ may take root in his system.

In passing the cup through the congregation, both the healthy and the unhealthy drink from it. If a communicant should happen to be suffering from any of the diseases that lodge their germs in the mouth, the most liable thing will be to drop the ephithelium scale into the wine, and then pass the goblet to his neighbor, who taking the wine drinks it unexpectingly.

Dr. C. Forbes, an eminent bacteriologist, has done more than any other man in America to bring about a change. He is a member of the Central Presbyterian church of Rochestsr, which was the first congregation in the country to adopt the new pro-

cess. He was also sent by his church to the general assembly of the Presbyterian church in Saratoga to instruct that body about the change and the necessity for making it. There is no doubt that every evangelical church in the land will eventually adopt the method now in vogue in Rochester, Albany, Philadelphia, Boston, and elsewhere. The new process of administering wine is demanded by the highest scientific and sanitary reasons.

After a careful investigation into the dregs of wine left after communion service at several churches in Rochester, a microscope revealed twenty-two living microbs, any one of which could have worked incalculable harm in the system of any person who happened to embibe them. No one can tell the number of germs taken by the communicants on the Sunday that the examination was made, nor the results which will follow. This uncleanly habit of sipping from the same cup has been in practice for so long that in its career it must have caused the death of thousands. However, the practice of partaking of the communion in wine is of such ancient origin, and it is so interwoven in the fibre of religion that it is a difficult matter to make the people see the necessity for adopting the new form. The new communion outfit, which was sanctioned by the general assembly of the Presbyterian church contains sixty small silver chalices about twice the size of a thimble placed in a three tier tray in small rungs. The chalices are protected when filled with wine by dust-protecting covers. The length of the tray is twenty-four inches and it is about five inches broad. A narrow handle reaches across the tray, so that the elders distributing the wine may carry it with ease. In giving the wine each communicant takes a cup and after drinking the wine leaves the cup in the pew. Enough cups are provided for each church so that every member has one.

Celloidin Imbedding.—Drop the scraps of tissue that are to be cut with a microtome into a paper box filled with fluid celloidin where they will naturally sink to the bottom. After the celloidin hardens, tear away the paper box and you have a beautiful block of celloidin. Then place it, bottom side up, in the microtome and the second cut will include sections of the imbedded tissues.

PRACTICAL SUGGESTIONS.

By L. A. WILLSON,
CLEVELAND, OHIO.

Algæ on a Sidewalk.—Noticing a bright green stain over many of the flagging stones in front of my house, I scraped up a small portion and placed it on a slide. A dissecting 'scope revealed that the material was too full of sand and grit to examine with a larger instrument. I therefore flooded the mass with water and with needles separated from the specimen as much of the sand and grit as possible. With a pair of forceps I then picked up the green mass and passed it through water and then removed it to a clean slide and with the forceps picked out the few particles of sand and grit remaining. I then had a very pretty slide of filamentous algæ. I account for its presence on the flagging by the fact that it is constantly watered with Lake Erie water which is always charged with the spores of the algæ. They may be permanently mounted in a solution of hydrate of chloral and will retain their refreshing green color in that medium.

Seeing Bacillus Tuberculosis with a Low Power.—If properly stained this object can be seen nicely with a one-quarter inch objective. All that an amateur would care to see can be thus exhibited. If stained red on a blue ground it will appear plainly and beautifully.

A Convenient Sub-stage Condenser.—A periscopic eye-piece set in the sub-stage with an adapter will afford a very good sub-stage condenser.

Polarizers are usually fitted with an adapter which may be removed and used with eye-piece in the sub-stage. The condenser certainly improves the performance of the microscope, it renders the light more pleasant to the eye and better defines the objects. Often, things hardly visible without the condenser. for example, bacilli tuberculosis, become distinct when it is employed. With low powers the condenser should be moved down away from the objective and with high powers brought up close to them. No one who has ever used a condenser would be without one. The light is also much improved by using a microscopic lamp with a blue glass inserted in the bull's eye.

THE MICROSCOPE.

SEPTEMBER, 1894.

NUMBER 21. NEW SERIES.

Objects Seen Under the Microscope.

XVI.—THE CRAB-LOUSE.

[Pen Drawings.]

In the order Hemiptera, sub-order Parisita and genus Pthirius is to be found the Crab-louse (*Pthirius pubis*). The one shown below has been drawn from a photo-micrograph made by Dr. W. C. Borden, U. S. N., with a Beck one-inch objective. These offensive creatures affect the pubic region and the arm pits of man. They

cling to the skin and make an irritating puncture in the flesh of the unclean persons upon whom they are parisitic.

"There are four prominent processes on each side of the abdomen, beset with long bristles, the posterior pair being the longest and most slender. It is about three-fourths of a line in length, by one-half a line in breadth.

A marked difference from all the other members of this family will be noticed here in the form of the fore-legs. These lack the heavy claws of the other pairs, and have, instead, a slender tapering form with a very slightly curved tarsal nail. The effect is to give them more ready means of moving over flat surfaces, and of turning over if thrown upon the back."—*Riverside Natural History.*

XVII.—Cyst of Trichina Spiralis.

This figure is also drawn from a photograph kindly sent us by Dr. Borden. The trichina is a worm which buries itself in the muscles of hogs, sheep, etc. When

the flesh of an infested animal is eaten, the encysted worm is dissolved out by the gastric juices and then progress is rapid. In a week millions of eggs are produced and soon hatched. The young then penetrate the walls of the intestine and set up a severe irritation throughout the body causing intense suffering. If the patient can get through the few weeks of suffering, the trichinæ will in turn become encysted and cease to do harm.

In 1884, the flesh from one pig killed and eaten in Saxony, Germany was tasted by 361 persons who took the malady and 57 of them died within four weeks.

These outbreaks occur when people eat raw meat. Cooking in the usual manner destroys the vitality of these animals. Hence, never eat sausage, pork, or ham until it has been thoroughly cooked. This whole subject has come to light through the use of the microscope since 1860 when Virchow and others demonstrated the dangers. The trichina was first seen by Hilton in 1835 but its real character remained a mystery until 1860.

On a Plate of Brass for Mounting Microscopic Objects.

BY ARTHUR M. EDWARDS, M. D.
NEWARK, N. J.

An observer of nature who does not have the facility of writing down what he thinks he has ascertained is to be pitied. But no two men are constituted the same. What you call facility perhaps another will not call facility and he writes better than you. But I say try to write what you think you see, and we will take it for granted you say what you think. But one who does not possess some knowledge of drawing is of course the man to be most pitied. But knowledge of drawing is rare and comes with inheritance as writing does but more rarely. We can cultivate the knowledge of writing to a certain extent but we cannot cultivate the knowledge of drawing. I remember one man who could write very well but he could not see any perspective and of course could not draw at all. My talent for drawing, of course I can call it with reason so; for talent is inherited. It can be traced to some father or mother, some uncle or aunt easily, and my children will inherit it somewhat. I believe in reversion of talent for it is undoubted, and it can be demonstrated. The facility of putting down on paper by means of writing is also plainly proved. What we are to-day, is an outcome of the piling up of what is

known as atavism or reversion. What we are to-day, is only the consequence of what our forefathers were, because they wrote in a certain manner; as I suppose for instance, I can write in the manner I do. We are creatures of circumstance and the consequence of what our ancestors were. What I do my grandson or nephew will do. For reversion seems to go by the uncle's side instead of the father. Why it is so we cannot of course make out. These thoughts on reversion come up in my mind in consequence of a talent, as I say I may call it, of writing and imitating which I have. I have invented a piece of apparatus for mounting microscopic objects and it is simple and I will describe it.

A piece of brass plate such as printers use,— a brass rule about five to the pica, as it is called, is taken. A piece three inches is cut off. It is one inch wide. To use this in mounting, a slide is laid on it and fastened by an American clothes clip. It has then the object put on it in water and arranged to suit the taste of the mounter or the method of the object. It is then heated with the brass plate down over a small lamp. A gas lamp is best but an alcohol lamp will do. A kerosene lamp will not do as it blackens by soot the brass plate. The heat is dispersed in the slide to the ends, and there is no danger of breaking the slide. When the object is dry, and before it begins to cool, gum or any preservative as Canada balsam, is placed on, and the cover put in place. I find this contrivance obviates the danger of breaking the slides by heat, also it diffuses the heat and keeps them wet with the preservative. I wish it might be tried for I think brass plate for mounting microscopic objects is a great desideratum.

Potassium permanganate is a newly discovered antidote to potassium cyanide. Administer one-half litre of a three to five per cent solution internally.

Immersion Objectives.

By A. C. STOKES, M. D.,

TRENTON, N. J.

From his new book "Microscopical Praxis."

Immersion-objectives are those that require a drop of liquid between the front lens and the cover-glass when in use. Among the advantages obtainable by their employment are increase of working-distance and increase of numerical aperture, with, as a consequence, the admission of more light, and especially the partial, or in some cases, the complete extinguishment of the cover-glass, by which its aberrations are obviated and two reflecting surfaces, those of the cover and of the front lens, are cancelled. The honor of discovering the principle is usually conceded to the renowned Italian professor, G. B. Amici, who exhibited water-immersion objectives at Paris in 1855. It is also said that he used oil as well as water for the immersion-medium, and that he therefore deserves the credit for originating oil-immersion objectives. For the modern homogeneous immersion, however, we are indebted to Mr. J. W. Stevenson, a well-known British microscopist. It was he who suggested to Professor Abbe and to Dr. Zeiss that they should turn their attention to the theoretical and the practical application of the principle; it is to him, therefore, that we owe this great modern advance in practical microscopy.

The use of immersion-objectives is attended by a little more inconvenience than that of dry objectives, and the immersion fluid is likely to be carried over the edge of the cover by the movements of the stage, and so is liable to mingle with the mounting medium in those preparations which are not permanently sealed. This annoyance may be avoided to a great extent by using square covers somewhat larger than the cement ring en-

closing the object, the movements of the stage then bringing the ring indistinctly into view, and the projecting borders of the square protecting both the immersion fluid above it, and the object beneath.

The front lens of these objectives must also be carefully cleaned and dried after the immersion-fluid has been as carefully applied. But the advantages obtainable more than counterbalance the inconveniences.

The fluid is always applied between the lens and the cover-glass. It is difficult to imagine any human being endowed with such unmitigated stupidity, that he should pour the immersion-liquid into the tube of the lens-mounting, yet instances of the kind have been reported.

It is recommended by some that the water, glycerine, oil or other fluid be applied in a small drop to the cover, and the objective racked down until the front lens comes in contact with it. The only advantage of this method, and that advantage is very slight, is that by it the probability of disarranging the object by the pressure of the thick liquid compressed between the cover and the lens, is lessened; and the reader may prefer this method, especially when using glycerine-immersion or homogeneous-immersion objectives, but a great disadvantage is that the moment the objective touches the liquid, the microscopist loses the power to appreciate the distance between the lens and the cover, and is therefore likely to rack down too far and so to do some damage, or not far enough and thus leave too much to be done by the fine-adjustment screw.

When using glycerine or homogeneous-fluid, I am in the habit of applying a drop to the front lens of the objective instead of to the cover-glass. This may be done by means of the cork from the bottle of fluid, a drop being allowed to form at one edge, whence it is carefully placed on the objective without touching the cork to the lens-front; or a rod may be forced through the cork and

the drop adhering to this applied to the lens. One leg of a rubber hair-pin forced through the cork is useful for the purpose, as none of the chemical liquids used for immersion purposes will act on it, as some of them will act on a metal wire. When the drop has been applied to the front of the lens, the objective is attached to the body-tube and racked down until the fluid touches the cover; and as the microscopist looks across the slide, between the cover and the lens, the objective is still further lowered while the lessening distance and the expansion of the fluid are watched, the expansion being continued until the objective is supposed to be approximately focussed, when the fine-adjustment focusses it upward or downward to the proper point. These movements demand exceedingly great deliberation and caution; deliberation so that the object may not be disarranged by the slow expansion of the thick immersion-fluid, if it is not permanently mounted, and caution that the objective be not injured, for immersion lenses are easily disordered. Their lenses are larger than those of smaller angled dry objectives, their construction is more delicate, and they must be treated with more care.

When a water-immersion is to be used, that is, an objective with which water is the immersion liquid, I am accustomed to focus it as a dry objective, as may easily be done, although the definition will probably be abominable and the field dimly lighted, yet enough may be seen to show that the desired object is in view. With a camel's-hair brush a drop of water is then added to the cover near the edge of the objective, under which it will run by capillary attraction. Here all danger of forcing the object out of position or of injuring the objective or the cover, is with ordinary caution, reduced to nothing.

To clean the front of a water-immersion, after using it, the careful employment of the Japanese filter-paper

is all that is needed. To remove the glycerine when used by itself or in combination with a salt, as in the homogeneous-immersion fluids, I am accustomed to wipe away the greater portion with the Japanese paper, and to remove the rest with a few touches of the tongue, finishing with the dry paper.

The cedar-oil used with homogeneous-immersion lenses is thickened with dammar, so that a touch of the moist tongue is likely to cause a deposit of some of the gum on the lens, and to necessitate repeated applications of the paper moistened with alcohol to remove it.* It is better with this liquid to employ the paper alone, and to finish with another piece moistened with alcohol, and to wipe the lens dry and perfectly clean with still another piece.

It is always well to clean an immersion-objective as soon as possible after using it. I have known instances in which the front lens was so insecurely burnished into the metal cell that the fluid has penetrated to the back of the glass, and made necessary a journey to the manufacturer. When the objective is to be out of use for only a short time, it should be placed on the table with the glass surface upward, and when the evening's work is finished, it should be carefully returned to its brass box, after a scrupulously neat cleaning.

When about to measure the angular aperture of an immersion-objective the front must of course be immersed in the proper medium. This may be done by applying a thin cover-glass to the front lens by means of a drop of its special fluid. It is better however, to estimate the numerical aperture by the method already described.

* Since this was written I have received from the Bausch & Lomb Optical Company, a supply of cedar-oil not open to this objection.

A Few Hints on the Selection of a Microscope.

BY DANIEL E. HAAG, M. D.
TOLEDO, OHIO.

The expert microscopist is able to select for himself, and we venture advice only to the beginner and inexperienced. It is not necessary for the practical, every-day work of the physician that he possess a costly microscope and numerous accessories, but it is desirable to have a good, solid stand, with perfect adjustments, and clear, well-defining objectives.

The first thing, then for consideration in selecting an instrument is the stand. With a good, well made stand free from lateral motion, both coarse and fine adjustments without back-lurch or lost motion, use can be made of such quality of optical parts as requirements may demand or means justify; but with a poor stand the best optical parts will prove an annoyance and a failure. It should possess a good smooth coarse adjustment by means of a rack and pinion, and perfect fine adjustment by micrometer screw; its entire construction should be devised solely for the purpose of using the optical parts to the best advantage. It matters not, and there is no optical advantage in either the long or short tube, provided it has a point for inclination, and the objectives be corrected to correspond with the given length of the tube.

So far as the metal of which the stand is made is concerned, there is no difference whether it be partly of japaned iron or all brass; this can be determined by the amount of money to be expended. While it is advisable to have the stage low, on account of the convenience of manipulation, yet there should be sufficient space for the convenient attachment of sub-stage accessories. As a general rule the American pattern of stands provides more space between the stage and base on the lower side, and stage and tube on the upper side, than foreign stands do.

A movable stage, while not an absolute necessity, neither simply a luxury, is yet a great convenience and a pleasure to work with. For biological work a condenser becomes almost a necessity, and as it must be adjusted for different objectives, the sub-stage must be moveable on the sub-stage bar; a condenser can then be supplied at any future time, without additional expense for after changes in the stand.

The mirror should be double, plain and concave, and swing on the mirror bar and be capable of being brought nearer to or further from the stage.

Two eyepieces should accompany the stand, A and B, or perhaps, C, will usually meet the requirements.

For bacteriological examination a good dry $\frac{1}{8}$, or better still a 1–10 or 1–12 inch homogeneous immersion objective will be necessary; but for all ordinary professional use two objectives will answer every purpose for a long time including urinary examinations for the various crystalline deposits, tube casts, blood, pus, etc. A 1 inch of an angular aperture of 25 degrees, and a 1–5 inch of angular aperture of 75 or 80 degrees: or a 2–3 or 3–4 inch objective of 27 degrees of angular aperture, and a 1–6 inch objective of 110 degrees of angular aperture will be amply sufficient. Either the 1–5 or 1–6 objective with the C eyepiece will, with a little eye training, on well stained specimens show the bacilli of tuberculosis. The question is not so much how many diameters will the objective magnify but, what will it show. A well corrected low power objective of wide angle will show more of detail and structure than a poorly corrected and narrow angle high power objective.

It is true that from an optical standpoint objectives give more detail as they increase in their angular aperture yet the highest class of objectives are not always to be preferred. The lenses here advised are not expensive glasses, and yet they will do fine enough work of the

kind for which they are recommended, as a great portion of every-day work, especially of a physician, does not require the maximum of optical performance, and can be as well accomplished, and with less skill of manipulation with glasses of comparatively low aperture.

Such an outfit can be purchased for a sum ranging from $40 to $60, so that the excuse of too great an expense at the start is no longer a good one. But the price alone must not induce one to purchase without any reference to quality. In contemplating the purchase of an instrument we should always be cautious of objectives recommended for their cheapness alone; especially so of objectives not bearing the name of a maker as it is fair to assume that if a maker does not attach his name he knows of their doubtful quality. The inexperienced should always in purchasing, reserve the right of having them examined by an expert. It will require but a short time, in comparing inferior instruments with one of reliable work to discover the inferior quality of the optical parts, and will then not only prove a source of disappointment, but a pecuniary loss as well as it will necessitate a future outlay for reliable work, or may lead to discouragementand abandonment of a fascinating and practically useful study.—*Toledo Medical Compend.*

THE THERAPEUTICS OF GLYCOZONE, COMPOSITION AND CHARACTERISTICS.

By Cyrus Edson. M. D.

Health Commissioner, Board of Health, New York City.

Glycozone is defined by its discoverer, Mr. Ch. Marchand, to be a stable compound, resulting from the chemical reaction that takes place when c. p. glycerine is submitted, under certain conditions, to the action of fifteen times its own volume of ozone, under normal atmospheric pressure at a temperature of 0°C.

The necessity of using c. p. glycerine is imperative, as a presence of the water or other foreign matter in the glycerine causes the production in the resulting compound of formic acid, glyceric acid, and other secondary products, that have a harmful effect upon animal tissues.

Glycozone has a pleasant, sweetish taste. Being hydroscopic it must be kept in tightly corked bottles, and, as long as it is kept in this condition, it does not deteriorate at a temperature of even 110 degrees F.

Antagonists and Incompatibles.—Glycozone. like peroxide of hydrogen is a powerful oxidizing agent, although its action is not as rapid or as energetic in this respect as the latter compound. Consequently, we cannot safely prescribe it combined with any other drugs or chemical substances. Contact with metalic utensils decompose it. We must therefore use glass or hard rubber vessels and syringes when administering it.

Physiological Action.—When taken into the mouth and stomach glycozone causes a feeling of warmth. It excites a flow of saliva and stimulates the gastric secretions. Being hydroscopic it attracts to itself water from the surrounding tissues but not with sufficient power to effect harm. This property is due solely to the glycerine base which enters into the composition. In very large doses, one or two ounces, it causes a feeling of distress in the epigastrium and is followed by loose, copious, watery stools, which are accompanied by severe cramps.

No effect is noted on the kidneys, the liver or the heart. Glycozone is undoubtedly slowly decomposed in the stomach, ozone being liberated and the glycerine uniting with the water from the tissues. The morbid elements with which it comes in contact probably hasten this decomposition, and in so doing are themselves oxidized and destroyed. The free ozone in the stomach resulting from the decomposition of glycozone aids the digestive process by its presence.

Therapy.—Glycozone is, in the opinion of the writer, the best known agent for the treatment of gastric ulcer. It is also one of the best remedies for the treatment of the stomach, catarrh of chronic alcoholism, and for chronic gastric catarrh from other causes. It is excellent for atonic dyspepsia, and for acid dyspepsia. The writer has seen very gratifying results from its use in these distressing maladies.

In catarrhal and other stomachic diseases except gastric ulcer, the remedy is best administered in one or two teaspoonfuls in a wine-glassful of water immediately after meals. In the case of gastric ulcer the dose and dilution should be the same, but it is better to give it when the stomach is empty.

Glycozone has an excellent effect when used internally in cases of diphtheria. For this purpose a tablespoonful of glycozone is given in a wineglassful of water every three hours. As it is perfectly harmless it may be used without apprehension. The following treatment is excellent in cases of membranous croup: The nose, throat, mouth, pharynx and larynx should be sprayed copiously every two hours or so with a mixture of one ounce of Marchand's peroxide of hydrogen (medicinal), with four to six ounces of water.

The membranes are readily destroyed, and by using this remedy freely, their reproduction is prevented. Then one teaspoonful of glycozone, diluted in a wineglassful of water, administered three times a day, prevents any disturbance of the stomach and regulates the bowels.

Remarkable benefit may be derived in the treatment of diseased conditions (ulceration and chronic inflammation) of the rectum and lower gut, by enemata containing glycozone and for this purpose nothing excels the following formula:

Glycozone, 1 ounce.

Water, lukewarm, 12 ounces.

This should be mixed immediately before using and administered with a hard rubber syringé once daily. It is frequently desirable to use a smaller amount than the above mixture. The proportions 1 to 12, however should be maintained. In cases of fistula-in-ano and of rectal ulcerations low down, an ounce of lukewarm water containing a drachm of glycozone administered once or twice daily soon effects good and in cases of ulcer, pure and simple, may be expected to radically cure the diseased conditions.

External Uses.—After the cleansing of any diseased or suppurating surface by peroxide of hydrogen (medicinal), the application of glycozone stimulates healthly action and hastens the cure. For this purpose it has no superior in the entire range of therapeutics. It tends to check the discharge of irritating unwholesome secretions and to prevent the infection of

the sore by pathogenic organisms. Its action in this respect is explained by the fact that it is both powerfully antiseptic and stimulant.

Follicular Pharyngitis, chronic coryza and ulcerative stomatitis are all benefitted by frequent applications of glycozone. As an application to ulcerated cervix-uteri and in tumefied conditions of the cervix and uterus it is far superior to pure glycerine.

In these cases, and for the cure of leucorrhœa, the remedy should be applied on small rolls of lint, or absorbent cotton, the vagina having first been thoroughly washed with an injection of peroxide of hydrogen one part, water four parts. This procedure should be repeated twice daily.—*Times and Register.*

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CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

Microscope for Recreation.—The most important point in Dr. Dallinger's second lecture on The " Modern Microscope " at the Royal Institution was its use as an instrument for intellectual recreation. He pointed out that the vast strides made of late years in the construction of the instrument has greatly altered its fitness for use in the hands of the amateur. It was true that now as in the past to utilise the microscope in its highest powers, long training and specialised knowledge were requisite, which fact narrowed its area for recreative use. But this was true of all instruments of precision, and yet there existed no scientific instrument which, thanks to modern devel-

opment, left a broader area for the intelligent amateur who was willing to devote some little time to acquiring the necessary manipulative skill. The necessity for this latter accomplishment was greater with the modern instrument, not because its wonderful modern perfections had introduced complexity—on the contrary, they had simplified it—but, being the outcome and embodiment of mathematical certainty, it was only by using it on scientific principles—easily learned—that the finest results could be obtained. Dr. Dallinger is an expert of experts in the use of the microscope; but if he appears at times to talk above the heads of the general run of users of the microscope, he is only encouraging them to work away at a study which becomes more fascinating as the student progresses. In the course of his lecture he showed what could be done by the use of moderate powers in the hands of an intelligent novice, and it should be remembered that even experts have been novices once.

PRACTICAL SUGGESTIONS.

By L. A. WILLSON,
CLEVELAND, OHIO.

Mounting of Small Insects.—Most small insects may be mounted by soaking them in oil of cloves, then in turpentine and then placing them permanently in balsam. They should be permitted to soak in the oil of cloves and turpentine until they are perfectly transparent. The slightest moisture will cause a black discoloration when the object is placed in balsam. The method here indicated is suitable for soft insects such as fleas, green bugs, etc., but will not answer for the coleoptera or hard-shelled varieties. The latter should be immersed for a time in potassium hydrate before being placed in the oil of cloves or turpentine.

Microscopical Apparatus.—While shifts and expedients are proper for one who can afford nothing better, long experience will convince one that the microscope and its primary accessories can be purchased more cheaply and will be more satisfactory than any thing an amateur can devise. The makers are in the business; they possess the skill and have all the dies, instruments and machinery necessary to the produc-

tion of perfect work. The mere amateur or the one not equipped for the purpose can hardly hope or expect to equal the expert manufacturer. Imperfect machinery will always produce imperfect work. So while one may succeed in minor details, unless the main machinery is perfect the whole result will be wrong. It is also well that an amateur should purchase a few type slides from a dealer. The beauty and completeness of such slides will be guide posts along his line of progress. No one can discover everything and it is but the aggregation of ideas that constitutes our progress and our civilization.

Sections of Tapeworm.—Nature has divided tapeworms into sections. To mount a section it should be soaked in hydrate of potash, then washed and cleansed in water and then stained with carmine, hæmatoxylin or some other suitable stain. But the amateur should be very careful in handling these sections, for each section, below the head, contains myriads of eggs and one minute egg from the finger to the mouth, would pass to the stomach, then into the circulation, and finally to the brain where convulsions and death are caused. It is a good object for amateurs to let alone. Students in this department are especially liable to danger.

Æcidia or Cluster Cups.—These are beautiful objects for low powers of the microscope. They are found in leaves in the spring. They were formerly supposed to be distinct species and are still classified as such in foreign works. They are now known to constitute the initial stage of higher fungi. A section of a leaf with a cluster cup is an instructive object for a quarter inch objective. See Bessy's Botany, page 311 and see M. C. Cooke, Microscopic Fungi, Chap. 1.

Celloidin Imbedding.—Drop the scraps of tissue that are to be cut with a microtome into a paper box filled with fluid celloidin where they will naturally sink to the bottom. After the celloidin hardens, tear away the paper box and you have a beautiful block of celloidin. Then place it, bottom side up, in the microtome and the second cut will include sections of the imbedded tissues.

To Clean Balsam Mounts.—Use a strong solution of caustic potash. Apply with a brush.

THE MICROSCOPE.

OCTOBER, 1894.

NUMBER 22. NEW SERIES.

Objects Seen Under the Microscope.

XVIII.—A NEW DICTYOSPHÆRIUM.

[Pen Drawings.]

Through the kindness of Mr. Thomas Craig, we are able to present the accompanying illustration. It is a

view of a newly discovered plant. It was found along

with other algæ, tangled in the roots of water cress in a pond on Staten Island (back of the Moravian cemetery). The beauty and regularity of outline of this plant is remarkable. The drawing was made by Mr. G. Dupuy. In size the plant is only about 5 mm. in diameter or smaller than the head of one of the smallest of pins.

The plant is enclosed in a globular envelope of transparent jelly, the outside of which is of a slight yellow tint, caused presumably by age or some staining material in the water. From a point in the centre of the globular mass sixteen faint silvery-like filaments radiate to near the circumference, where each filament is crowned with a cluster of twelve to fourteen fusiform, curved, bright green cells, each attached to the filament by one end. The cells, in length, are about five times the width. The cells are filled with a green material slightly granular and much condensed at the outer end. A well defined and large nucleus occupies the centre of each cell. The part of the cell nearest the filament is only faintly green.

In Wolle's description of this genus he describes the cells as green, and egg or kidney shaped, united in a globose hollow family, involved in a gelatinous integument. He describes four species: *D. pulchellum*, Wood, *D. reniforme*, Bulnh, and *D. Hitchcockii*, Wolle. The one under consideration does not agree in description with any of the above species.

A Note, Incidentally in Regard to the Animality of the Diatom, but Especially to Mr. Cunningham's Method of Illumination.

BY DR. ALFRED C. STOKES,
TRENTON, N. J.

In reference to Mr. Cunningham's contention that the diatom is an animal I have nothing to say, except that I do not believe it; and in regard to his claim that he has

proved that animality, I do not hesitate to say that in my opinion he has done nothing of the kind. He entitles his paper "The Diatom Considered as a Protozoan, with Method of Demonstration," and says, on page 231 of the Microscopical Journal for August last, that if certain events had not occurred "I would have had to continue in the mental attitude of one who strongly suspects the animal character of the motile diatoms, but cannot crystallize his proof into a concrete expression for lack of demonstrable evidence. But this stage has been safely passed and an easy method of verification is accessible to all who use the microscope as an instrument of research, or for biological studies of any kind." If this and his title mean what they seem to say, then Mr. Cunningham asserts that he has proved the diatom to be an animal, and that any one accustomed to the use of the microscope can repeat that proof. Mr. Cunningham deserves credit for the courage that supports him in the publishing of these convictions.

But personally, I should have read his interesting article with more confidence, if he had not been so careful to explain his method of illuminating the instrument and of using the condenser. His explanations of these points vitiate his entire paper, and render almost worthless what otherwise might have merited some consideration.

For the elucidation, and especially for the teaching of such fine points as Mr. Cunningham has undertaken to demonstrate, nothing short of what is called critical illumination and the production of the critical image, should have received his earliest attention. On the contrary, by his own showing, he has examined his specimens in what is describable only as an optical mess; he then says that he has proved the animality of the diatom, and seems to expect the readers of this Journal to accept his teaching in opposition to what has stood the test, and been universally received, for years.

He says (page 234): "In regard to the lighting, and some other requisites of illumination, an Argand burner lamp is used, a bull's-eye condenser being adjusted as near as possible to the flame, and a large image of the flame projected so as to fall on the concave face of the mirror." He not only uses a convex flame-surface, but he endeavors to condense the light on the concave mirror, when the source of that light is not in the focus of the bull's-eye, since he puts the bull's-eye "as near as possible to the flame." This might not be so bad, but "To the sub-stage," he continues, "an achromatic condenser is adapted, and when the light is properly centered in the field, the result will be a dazzling light. But in order to guarantee the successful view of the various phenomena, it is necessary to have at hand a glass slip, or a smaller piece of emerald or grass-green colored glass (blue will not answer). This slip must be placed on top of the condenser, or the slide containing the living diatoms must rest directly upon the green glass slip."

If this again means what it says, then Mr. Cunningham uses the concave mirror with the achromatic condenser, having the bull's-eye placed between the mirror and the light but not focussed, and the condenser itself out of focus, whether within or without it is hardly possible to guess, but probably without; and to "make confusion worse confounded," he inverts a small-angled, half-inch objective and uses it as an eye-piece. When these things have been accomplished, Mr. Cunningham gravely describes his observations, and not only expects the general reader of this Journal to treat his paper as something more than an "American joke," but he seems to want expert microscopists and biologists, learned diatomists and naturalists, to accept the statement that he has proved the motile diatoms to be animals, and proved it by the optical methods, or rather by the absence of optical methods, which he so explicitly details.

If I use pungent English in thus expressing my personal opinion, it is not that I have any unfriendly feeling toward Mr. Cunningham, for whom I have nothing but respect, and the greatest commiseration in the formidable task that he has set for himself; it is not because I think him wrong in his conclusions; nor that I am anxious to appear in print with harsh criticism, as I am not, for I have asked the editor to destroy my manuscript if any other person has enough interest in the subject to call attention to Mr. Cunningham's reprehensible method of illumination, especially reprehensible when he is laboring to overthrow the accepted teaching of the most learned specialists. He may have proved what he claims. I do not think he has; but aside from this part of the subject, the methods of illumination by which he arrived at his conclusions are open to the gravest criticism, and the results obtained in such circumstances, always remembering Mr. Cunningham's purpose, are to be considered, even slightly, only after he has corrected what must have been an oversight, an omission made when his thoughts were busy with an observation that might be a startling discovery, and result in the transferring of a great group from one natural kingdom to another. Microscopical objects used as a basis for assertions as important as Mr. Cunningham's would be if they were proved, demand, in these days, not only the most careful illumination with the best optical appliances, but the results must be almost worthless unless the observations are made with wide-angled, oil-immersion objectives, with an achromatic condenser having a numerical aperture approximating that of the objective used, and perhaps with compensating eye-pieces, certainly not with an old-fashioned, half-inch objective reversed and employed as an ocular. And why Mr. Cunningham shoulp use grass-green glass and condemn blue glass which, when of the proper shade, is commended by microscopists the world over, I do not comprehend.

The Oldest Fossils, Microscopic.

By ARTHUR M. EDWARDS, M. D.
NEWARK, N. J.

About two years since, Dr. Chartes Barrois announced in a brief note to the "Comptes Rendus," the discovery of Radiolaria in the Pre-Cambrian rocks of the horizon of the mineral schists and phyllites of St. Lo, in the north of Brittany, France. The further description of these, probably the oldest fossils known, older than the Eozoon Canadense, was intrusted to M. E. Cayeux, who had considerable experience in the study of Radiolaria and other microscopic organisms in the Cretaceous works; and the first announcement has just come to me from M. Cayeux.

There can be no doubt with respect to the Pre-Cambrian rocks in the section where the Radiolaria were found. There are bands of phthalate from half an inch to over three feet in thickness, interstratified with schists. The phthalate are principally crystalline silico and a certain amount of carbonaceous material is also present in them. The presence of Radiolaria shows that the carbonaceous material is organic matter like the carbonaceous material in the Laurentian rock where the Eozoon is found. The Radiolaria is distributed in the phthalate irregularily, sometimes occurring singly, at others in great numbers closely associated together, so as occassionally to be in actual contact. They are exceedingly small in size—.001 mm. to .022 mm. in diameter—and to observe their structures it is needful to use much higher objectives than those required for other fossils and for recent Radiolaria.

By far the larger number are spherical in form; some are elipsoidal, and there are many varieties of the inflated or cyrtoidal bell-shaped forms. One or more radial spines occur in several forms and in two or three, an inner concentric shell connected by rays with the

outer test has been detected. Most of the forms figured have holes or perferations in the outer test, thus showing a lattice-like structure.

M. Cayeux has figured 45 different forms assigned to 19 genera of Radiolaria. The figures are drawn by an artist totally unacquainted with those organisms and therefore unbiassed. They present strong prima facie resemblance to known Radiolaria. The small size of the Pre-Cambrian bodies compared with undoubted recent Radiolaria is marked but is of course accounted for. Dr. Rust who examined the Pre-Cambrian bodies thinks some of them move like Foramenifera than Radiolaria. That they are organic forms there is no doubt.

In the words of G. J. Hinde, "the importance determining the real character of the minute bodies in these Pre-Cambrian rocks will be generally recognized and we trust the author will persevere in his researches until he meets with evidence sufficient to convince those who now feel some hesitation in accepting his conclusions about them."

Walker Prizes in Natural History.

BY SAMUEL HENSHAW, SECRETARY.

Boston Society of Natural History, Boston, Mass.

By the provision of the will of the late Dr. William Johnson Walker two prizes are annually offered by the Boston Society of Natural History for the best memoirs written in the English language on subjects proposed by a committee appointed by the Council.

For the best memoir presented a prize of sixty dollars may be awarded; if, however, the memoir be one of marked merit, the amount may be increased to one hundred dollars, at the discretion of the committee.

For the next best memoir, a prize not exceeding fifty dollars may be awarded.

Prizes will not be awarded unless the memoirs presented are of adequate merit.

The competition for these prizes is not restricted, but open to all.

Each memoir must be accompanied by a sealed envelope enclosing the author's name and superscribed with a motto corresponding to one borne by the manuscript, and must be in the hands of the Secretary on or before April 1st of the year for which the prize is offered.

Subjects for 1895 :—

(1) A study of the "Fall line" in New Jersey.

(2) A study of the Devonian formation of the Ohio basin.

(3) Relations of the order Plantaginaceae.

(4) Experimental investigations in morphology or embryology.

Subjects for 1896 :—

(1) A study of the area of schistose or foliated rocks in the eastern United States.

(2) A study of the development of river valleys in some considerable area or folded or faulted Appalachian structure in Pennsylvania, Virginia, or Tennesee.

(3) An experimental study of the effects of close-fertilization in the case of some plant of short cycle.

(4) Contributions to our knowledge of the general morphology or the general physiology of any animal except man.

NOTE.—In all cases the memoirs are to be based on a considerable body of original work, as well as on a general review of the literature of the subject.

To Prevent Vegetable Sections Turning Dark.—Soak in alcohol to which 2 per cent of hydrochloric acid has been added and let them dry slowly.

Bleaching Leaves.—Chlorinated soda is the best fluid for bleaching vegetable specimens.

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CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

Stokes vs. Cunningham.—In order to excite interest and make matters lively, we publish in this number an article by Dr. Stokes, the former editor of this periodical, attacking quite vigorously a recent article by Mr. Cunningham the well known expert in diatoms. Although there have elapsed two months since the publication of Mr. Cunningham's paper, no one but Dr. Stokes has written us attacking it, and the latter's request to destroy his manuscript in case some other correspondent should notice the matter has been respected. Mr. Cunningham, strange as it may seem, has requested its publication; and will, it is presumed, defend himself in due time. Lively times are ahead or else a graceful retreat for somebody. We shall see who will play the General McClellan in this case. By the way, was not McClellan a New Jerseyite?

More Booes.—A new Handbook of Medical Microscopy, this time by James E. Reeves, M. D., is announced. It seems as though Wethered's ought to have been sufficient for the present, but when we see Reeves' we may feel differently. Dr. Reeves has practiced medicine forty years and has doubtless tested most of what he writes about.

Sand Grains.—A Mr. Watt, of 144 High street, Elgin, Scotland, has published a little pamphlet on sand grains, explaining the utility of the microscope in examining the constituents of rocks, etc. We should like to see a copy.

QUESTIONS ANSWERED.

NOTE.—*Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of all grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.*

202. *Who are the best authors on histology and urinary analysis? —Hardy.*

Tyson, Examination of Urine, cost $1 50.
Hofmann and Ultzmann, Analysis of Urine, cost $2.00.
Klein, Elements of Histology, cost $1.75
Stirling, Practical Histology, cost $3.00.
All are good works on their subjects.

203. *Is the "Wenham" stand described in Hogg's "The Microscope," now on sale? Is it not a very good one?—R. Rich.*

The stand figured in Hogg, was intended to illustrate a binocular stand furnished with a Wenham prism; the Wenham prism is the one commonly used in binocular stands and is a very good one.

204. *Who now sells the Bullock stands?—R. Rich.*

E. B. Meyrowitz, 104 E. 23rd St., New York.

205. *What is a "Spot Lens"?—S.*

Carpenter says a spot lens is a condenser with a permanent axial stop fixed in it to cut off the central rays for the purpose of obtaining a dark ground upon which the illuminated object lies. Obviously it is not a desirable accessory. It is a condenser, but having a fixed stop it can only be used for this mode of illumination.

PRACTICAL SUGGESTIONS.

By L. A. WILLSON,

CLEVELAND, OHIO.

A Double Nose-Piece.—The part of a double nose-piece supporting the unused objective should stand perpendicularly out from the tube of the microscope. If allowed to be on one side it will prevent the proper revolution of the objectives and will subject them to great danger. No accessory can afford more comfort, save more time or wear and tear than a nose-piece.

Leaves of Deutzia.—Elaborate directions are often given for the preparation of slides of Deutzia leaves. Nothing can excel a slide made by simply pressing and drying the leaves and mounting them as opaque objects.

The number of points to the stars vary on the different sides of the leaf. The stars polarize nicely, but as a polarizing objects should be prepared by removing the cuticle and mounting it with the stars as a transparent object.

A Dissecting Microscope.—For good work in mounting, a dissecting microscope is an almost indispensable accessory. Fine instruments of this kind are supplied by dealers. The beginner, with the exercise of a little ingenuity, can improvise a serviceable instrument for the purpose. The essentials are a stage to work on, a simple lens held by a pillar, and a mirror to cast light upon the object.

The lens should be adjustable for focus. A reading glass or a set of cheap lenses will do the work. Much magnification is not proper or requisite. The same thing may be accomplished with a pair of watch-maker's glasses fixed to the eyes while dissecting. Without some sort of arrangement, preparations will be clumsy and the most beautiful and instructive parts of a specimen will generally be obscured or neglected.

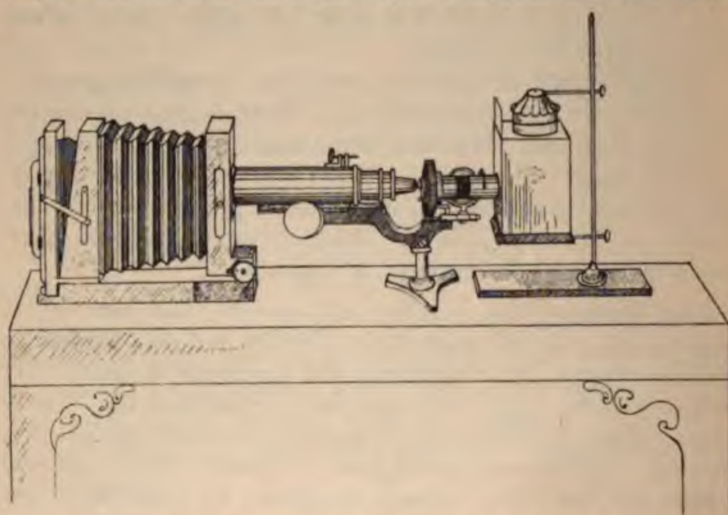
Leaf Fungi.—The simplest and probably the best way to keep leaf fungi for the microscope is to dry and press the leaves, with the fungus, and then wrap the specimens in papers, recording on the paper the name of the specimen, the locality where found, and the kind of leaf on which the specimen is growing. The leaves can be used as opaque objects and will exhibit the fungus in a natural condition; by removing a few spores with a spatula, placing them in a drop of water and examining them with a quarter-inch objective they will appear to the best advantage. Mounting is apt to shrivel and distort the spores and give but a faint idea of the natural object.

Dark Ground Illumination.—This may be produced without any accessory by simple using oblique light upon a transparent object. Set the microscope sidewise upon the table, turn the mirror obliquely and set the lamp so that the rays of light will strike the concave mirror. Butterfly scales, pollen, a living cyclops and thousands of other objects are beautiful

when examined in this manner. When properly done, the effect is equal to a spot lens or a parabaloid.

CORRESPONDENCE.

Dr. Shufeldt's Improvised Apparatus for Making Micro-Photographs of the Parasites of Birds.—Every one of us who have collected birds have often noticed that if the specimens are set aside for a few hours, and the bodies become cold, numerous little parasites which have infested them during life now crawl out upon the ends of the feathers or bristles around the base of the mandibles. Here they will often remain until they starve to death and fall off, or disappear in other ways.



Hundreds of times I have looked at them with a high-power hand-lens with great interest, but never made any sketches of them, as I had at that time devised no means to do so with accuracy. Later, I was again attracted to the subject, but owned no micro-photographing instrument of any kind. But a day or so ago I determined to overcome this most serious difficulty and improvise a micro-photographing apparatus of some form or other, and in the venture I succeeded far beyond my most sanguine expectations.

This is the way I did it, and my sketch of the affair as finally

set up will help my readers to comprehend my remarks about it. These I will give in some little detail as I hope to have others investigate and describe some of the parasites of our birds. Most naturalists nowadays own a camera and outfit, and also a microscope and its outfit. This is my case. In the first place, then, I took my largest camera and placed it on a long table as shown in the sketch. I removed its lens and lens-boards, and fitted a cardboard front to take its place. Next I took my largest microscope—a Beck's Monocular National—and brought it into the horizontal position. I fitted the upper end of its body, while in this position, into the cardboard front of the camera. A substage condenser, and a three-fourth inch objective were next attached to the microscope, and the camera and the latter coupled together. Now most micro-photographers omit using the eye-piece of the microscope, but with it I subsequently obtained the best results. It is inserted *after* the barrel or body of the microscope is run through the cardboard into the front part of the camera-box.

For an illuminator I used the dark-lantern of my photographic outfit—simply withdrawing the ruby-glass slide in front, and fitting in its place a thick piece of cardboard, into the center of which I inserted the lens from a small camera to act as a "bull's-eye condenser." This is coupled with the substage condenser on the microscope by means of a broad rubber band. My lantern I held nicely in the proper position by suspending it between the "rings" of a chemical standard, as shown in my sketch; but any simple device will hold your lantern up in its proper place. It can even be "built up" by putting books under it. Both the lantern and microscope rest upon a very thin board which travels with ease on the extension-bed of the camera-box. By this latter simple contrivance, focussing your specimen on the ground-glass of the camera is easily managed. The screws control the whole thing, and the rest can be with ease understood from my sketch of the plan adopted.—*Auk.*

SCIENCE-GOSSIP.

Hydrogen Dioxide.—This remarkable liquid which contains the greatest percentage of oxygen of any compound known, was, for sometime, considered as a mere solution of oxygen in water, and consequently was called oxygenated water. It was

afterward obtained free from water and found to be a definite chemical compound of hydrogen and oxygen, and differing from water in containing twice as much oxygen. In this state it is a heavy, oily liquid, readily decomposed at ordinary temperatures but if heated, with explosive violence, being converted into ord, inary water and oxygen gas. When poured into water it sinks, being nearly half again as heavy as that liquid, but is miscible in all proportions with it. It has a somewhat bitter, astringent taste, and is colorless, transparent and without odor. It bleaches the skin, hair, ivory and destroys organic coloring matter, pus and all organisms with which it comes in contact by liberating oxygen gas in a nascent or active state.

The preparations found in commerce are only solutions of this compound in water, and sold in different degrees of concentration or strength, rated by the number of volumes of oxygen gas they can be made to yield. A fifteen volume solution is one that will give off fifteen volumes of gas from one volume of the solution. A ten volume solution will yield ten pints of oxygen gas from one pint of the solution, and so on.

These solutions, although more stable than mere concentrated preparations, nevertheless decompose and lose their nascent oxygen on which its powerful antiseptic powers depend, and consequently we find the commercial brands varying considerably from their reputed strengths. The solution containing the greatest percentage of available oxygen is the preparation known as Marchand's, which, when perfectly fresh, is about a fifteen volume solution.

RECENT PUBLICATIONS.

The study of the Biology of Ferns by the Collodion Method. By G. F. Atkinson. 8° pp 134, New York, Macmillan & Co, Price $2.25.

To microscopists this book is of more interest than the ordinary treatise upon biology on account of its technique. It is especially to be recommended to microscopists because the author is in thorough sympathy with us in all of our purposes.

He is a teacher and a skilled microscopist, in every manner qualified to write on such a topic. His book contains a record of his own work and discoveries.

THE MICROSCOPE.

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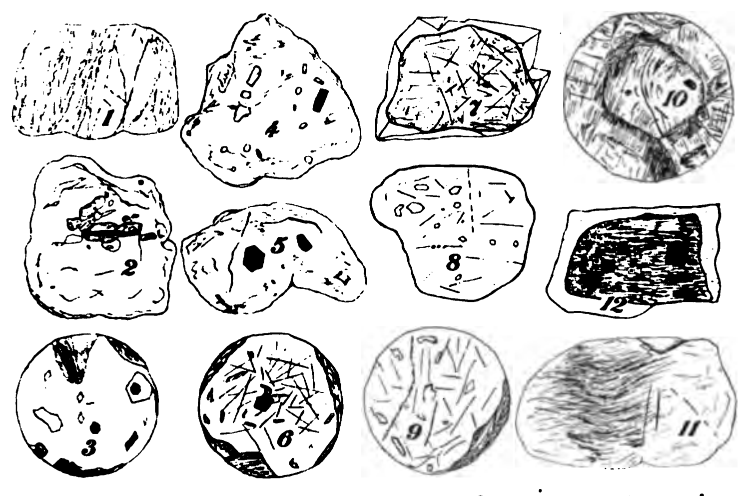
Objects Seen Under the Microscope.

Sand Grains and What We May Learn From Them.

By WILLIAM MACKIE,

ELGIN, ENGLAND.

If we were to take 100 grains of sea sand from the seashore, and examine them under the microscope, with the view of determining their characters, we should prob-



ably find that, out of that number, 86 were quartz grains, perhaps about 6 felspar, perhaps 2 garnet, perhaps 1 mica and the remaining 5 indefinite, consisting possibly of quartz or felspar stained past recognition with oxide of iron (rust), chips of schistose rock, and others of whose characters perhaps no opinion could possibly be given.

Passing from sea sand to the sand grains of our sandstones, we should find very much the same thing obtained. Sea sand forms, perhaps, the mean between the extremes in composition of the various sandstone beds. These, I find, vary from

72 per cent to 96 per cent for quartz,
16 per cent down to 0 per cent for felspar,
2 per cent down to 0 per cent for garnet,
5 per cent or 4 per cent down to 0 per cent for mica.

Occasionally one or two other unimportant minerals are added, but these are of little interest so far as the purpose in hand is concerned.

Now, why, first of all, this enormous disproportion between the number of quartz grains and the other constituents? Sandstones, as you all know, are derivative rocks. The substances of which they are composed did not exist from all time as integral parts of the present sandstones. These rocks have been built up of the fragments of older, of pre-existing rocks. To anticipate for a moment some of our results, I find that these sandstones have been largely derived from the waste of gneiss and granite. Now, both of these contain felspar in quite as large proportion as quartz. Why does this not appear in the result—I mean in the re-formed sandstone? Because the felspar is more easily broken down, breaks down into finer dust, and is, consequently, washed faster and farther away than the quartz, which, being the hardest, most resistent of our widely distributed minerals, remains behind in larger, heavier grains, and so the process of separation is effected. The mica, which is also a constant constituent of the original rocks, being more easily buoyed up in virtue of its flat, scaly condition, is easily floated away, and hence the quartz is left, as one might say, in almost sole possession of the field.

Now, our object is to trace these grains of quartz back to the rocks whence they were originally derived. If these grains were composed of perfectly homogeneous

quartz—that is, of absolutely unqualified or unadulterated oxide of Silicon—for that is what quartz really is—we should be able to learn very little regarding their previous history. The shape, size, and surface markings of the grains might tell us a little. When, for instance, we come across a grain striated as in figure 2, a striated grain of quartz from Boulder Clay, our thoughts at once go out to glaciated boulders and the Ice Age. It is like a miniature glaciated boulder, and is sufficiently realistic to give one a cold shiver. It is from the pit of Boulder Clay behind the Morayshire Combination Poorhouse, and many more—perhaps not all so finely marked—are to be found among the quartz grains of the Boulder Clay. As many as 15 per cent I find from my analyses are described under the heading "Striated." No doubt the friction of sand particles against one another under water causes many indefinite scratchings of their surfaces, but when we get several deep and roughly parallel groovings, such as we have here, I think we are justified in calling in the agency of glacier-ice as a more efficient cause. Our sea sand, again, by common consent acknowledged to be largely made up of the washings of old Boulder Clays, shows about 10 per cent of such striated grains; while among the sandstones they are seen particularly at Scaat Craig, which shows 8 per cent and among the rougher beds of Newton, 10 per cent of which are also noted as "Striated." The existence of striae in these latter confirms the theory of recurring glacial periods at various times in the remote geological past. One curious result that emerged from amid our maze of figures was the very significant one that a very large proportion of the striated grains are of granitic origin. This is equally true of the recent, as of the early, manifestations of glaciation. The explanation, probably, is that the operations of glacier ice were for the longest period, and in very large measure, confined to

the recesses of remote granite mountains, or, generally, its action was most strongly exerted in these localities. The fact, whatever its interpretation, remains, and though it did not lie in the particular line of our investigation, it is sufficiently interesting to be recorded as a bye-product.

The size and shape of the grains tell us very little of their previous history. If they are much rounded, we infer much tossing about the world, and a long journey from their original home to their temporary resting place in the sandstones. One would think that the smaller grains would naturally be the most rounded, from long tear and wear in transit from place to place. That, however, is not so. So far as the Elgin sandstones are concerned the very reverse is the case. The larger grains are almost invariably the more rounded. The reason, I think, is evident. The larger grains from their weight are more apt to be rolled along by the force of water, while the smaller are, so to speak, floated along, and hence do not suffer so much attrition from contact with other grains. So much for the adventitious characters of our sand grains. They practically tell us very little about their previous history.

Fortunately for our purpose quartz grains are not always homogeneous, and when we come to look at them closely with tLe microscope a whole vista of possibilities of learning something of their life history at once bursts on our astonished vision. If we look at quartz grains with a moderately high power of the microscope we find that many of them contain numerous little objects—some of them beautifully shaped, some of them beautifully colored, all of them essentially wonderful. These are what we call inclosures or inclusions in the quartz. They are sometimes other minerals in their regular crystalline forms enclosed in the quartz. Let us make certain what an inclusion really means.—Concrete examples of

inclusions, large enough to be seen with the naked eye, may be seen *e. g.*, quartz in felspar; garnet in mica; tourmaline in quartz.—Some of the quartz grains are perfect little museums of other minerals. But inclosures are not always minerals. Sometimes they are little spaces, little lakes—lacunae as we call them—filled or partially filled with fluid. Sometimes the fluid is pure water. Sometimes it is water saturated with common salt or other alkaline salt, and then little cubes of the salt may sometimes be seen lying loosely at the bottom of the cavity. Some of them, as an enterprising chemist has shown, are filled with carbonic acid in a liquid state. Note the internal pressure that implies. In some, again, a minute bubble of gas is seen floating along the top of the fluid as in a spirit level. When you turn the crystal round the bubble may sometimes be seen to move. When the cavity is very minute the bubble may have a spontaneous movement, and may be seen darting like a living thing from side to side and from end to end of the cavity, then returning to its original position, only to set out on its ceaseless round once more. It is not our purpose to go into the reasons why these inclosures are present in quartz grains. It is sufficient for the end we have in view that they are there, and that we learn something of the grain that includes them because they are included in it. We may classify inclusions into several groups:—

1. Those with regular mathematical outlines, shortly known as regular (figures 2, 3, 4).
2. Acicular, or fine needle-like inclusions (figures 6, 7).
3. Spirit-level.
4. Irregular outlined.

I. The regular forms are almost always crystals of other minerals. Among those that come under observation in our investigation may be mentioned quartz as an inclusion in quartz, garnet, black mica, chlorite, rutile, kyanite, apatite, &c. It is a case of identity we

are going to prove, and you know you can swear to a person's identity in a court of law without knowing his name. Rounded or ovoid fluid inclusions without gas bubbles are classified as regular.

II. Acicular. These are fine needles, sometimes very fine indeed; sometimes so fine that under the microscope they appear as Tennyson might have put it, "as a finer line in light." They are usually straight—a dead straight—and I know of nothing that so nearly represents the technical definition of a line as "length without breadth" as do some of these needles. Occasionally, however, we see a zigzag one running right through a crystal, and appearing to the eye very much the same as the forked lightning of the "Old Masters." These needles are generally fairly equally distributed through the grains, though, occasionally, they colonise in a particular part of it.

III. The spirit level kind hardly comes under observation at all. If they do, they are usually associated with members of the regular group, under which the grain is, in that case, classified.

IV. Irregular inclusions are very indefinite in shape and size. Some of them are empty, when they appear nearly black, as if the grains were daubed over with black ink spots. Some of them contain fluid with or without a bubble of gas. They are often so small that with ordinary powers of the microscope the grain appears inclusionless, and is so classified in the results. This source of error is, however, of no importance.

Now, you ask what is the meaning of all this. What use is it to be put to? My thesis—my contention is this—that, by reason of these inclusions, we are enabled, with very great certainty in many cases, to refer the individual grains to their parent rocks. Just in the same way as a geologist well acquainted with the geology of a district may go to a pit of Boulder Clay, and picking

up stone after stone would say to himself—"This is granite from the Central Grampians;" or, "this again is gneiss from somewhere between the Nairn and the Spey, this micaslate with garnets from the head waters of the Nairn," and so on. And just as the geologist may at times be able to refer a rock to a particular and very definite locality, at other times only to some indefinite point of a very wide range of country over which it may be known to exist *in situ*; so we, in virtue of these inclusions, may be able to refer our quartz grains sometimes to a very definite locality, sometimes only to an indefinite point of a very wide track indeed.

Now, it may be stated as broad generalities—to which I do not venture to say there are no exceptions—that regular inclusions are to be found in greatest numbers and in highest perfection in gneiss; that acicular crystals have their natural home in granite, and the irregular group also claim the same origin. Examples are shown of regular inclusions from gneiss of Findhorn and of Sloch-na-Muich (figure 3); the whole of which are paralleled by examples of regular inclusions in quartz grains from the whole of the series of the Elgin Sandstones (figures 4, 5,) they exist in varying proportions—from 14 per cent in Spynie to 48 per cent in the sea sand of Lossiemouth. Unfortunately, however, for our hope of establishing a rigid generalization, the local granites are found to contain regular inclusions in greater numbers than I can remember to be the case in any granites I have ever examined. This is due to the fact that all, or mostly all, of them have been derived from the gneiss by passing through a higher stage of the same metamorphic process which originally produced the gneiss itself—in other words, the process that produced the gneiss has gone a step farther and produced granite. There will, therefore, occasionally be some little difficulty as to the origin of a particular grain on this score; but means

have been taken to keep the error from this source as small as possible. As a rule, however, grains with regular inclusions are to be referred to the gneiss as their original home.

The acicular group has proved a very interesting one, for the reason that I have been able to trace most of them to very local and very definite origins (figures 6, 7). The group may be divided into some seven sub-groups, as follows:

GRAINS WITH ACICULAR INCLUSIONS.

1. Closely packed needles in clear quartz.
2. Closely packed needles in smoky quartz.
3. Associated with red or violet or dark hexagons.
4. Sparsely packed in yellowish quartz.
5. Associated with clear regular inclusions.
6. Zig-zag needles.
7. Very dark closely reticulated; only two specimens seen.

You will observe that all of them are granites. I think I have already sufficiently described all the members of the group, except, perhaps, group 3 (figures 8, 9). It is a very interesting one indeed. Sometimes the hexagons and needles are mixed up in inextricable confusion. At other times a needle starts out; it is interrupted; a few well-formed hexagons succeed at intervals along the same definite line; then the series is closed by another needle similar to the first, still extending in the same line. Sometimes a needle breaks into a series of very indefinite dots, to merge again into another needle at the other end; or again, lines of dots take the place of needles altogether. This is what we see with ordinary powers of the microscope, but, when we pass to higher and higher powers, these indefinite dots are found to resolve themselves into regular hexagons, in all respects similar to the larger. It is the old story of Herschel and the star-depths over again—only here rehearsed at the other pole of infinity. The more he increased the powers of his telescopes, the more and more did the hazy nebulæ

of space tend to resolve themselves into clustering groups of stars. The more we increase the power of our microscopes, the more and more does the indefinite dust of our quartz grains tend to body itself forth into definite crystalline forms with individualities as strongly marked as the starry worlds of space.

The evidence of the presence of quartz grains derived from Benrinnes granite is particularly convincing. That the three first groups of acicular grains should be found side by side in the sandstones, and in the granite is proof of identity beyond the possibility of dispute. The evidence of the presence of Ardclach granite is not so strong, though it is still considerable. With regard to Kinsteary, the whole case has not been stated. Let us study for a little the structure of this remarkable granite, which, in some respects, is very peculiar indeed. Here is a section of Kinsteary granite (figure 10). The first peculiarity of it is to be found in these grains which I have called "cleaved grains." These I believe to have been at first felspars—the original felspars of the granite, but at some period of its history the granite underwent a process of re-cooking, when new felspars began to crystallize round other centres, and in the process they robbed this earlier set of their basic constituents, and left them with the cleavage of felspars, but chiefly composed of quartz. Then, by the pressure of these young and growing felspars, their cleavage, while they were still in a plastic condition, was deformed and thrown into irregular wavy lines (figure 11). Now, similar grains occur in the sandstones from Newton upwards and, as if to make assurance doubly sure, a crystal of this ruby mineral, a cube of black magnetite, or a fine needle, as here, is added.

Again, as has been hinted, the felspars of Kinsteary are peculiar (figure 12). They show a dark nucleus often containing grains of magnetite with a clear margin

all round. Similar felspars have been seen in almost all specimens of the sands examined from Newton upwards.

There is also some evidence to show that quartz grains from the granite twenty miles up the Nairn, are also to be found among the grains of the upper members of the series. These consist of grains made up as it were of many smaller quartz crystals seemingly dovetailed together. They produce a peculiar effect when examined with polarized light; and the grains in the granite and the sandstones have this effect in common. Such grains are also to be found in some of the other granites, but these are the most typical, and correspond most closely to the grains in the sandstones.

It should be stated, that when sand grains are built up into sandstones, secondary quartz is apt to be deposited around the sand grains by water containing silica in solution percolating through the beds, and depositing it between the original grains. When we come to examine the grains after separation for the purpose of analysis, they often have clear bands of this secondary quartz around them (figure 7). But when we have discounted all this secondary quartz in the Spynie sandstones, there are many grains that do not differ widely from regular mathematical forms. Now such grains do not occur in granite, they do not occur in gneiss. The only rock I know that shows such grains is quartz-felsite—which is nowhere, so far as I know, found *in situ* in this locality now, but is common in two varieties among the pebbles on the shore at Lossiemouth.

[We quote the foregoing, which will prove of the greatest interest to our readers, from a pamphlet Entitled "Sand Grains," which is for sale by Alexander Watt, 144 High Street, Elgin, England, to whom we advise our readers to apply for the entire treatise of 32 pages. Enclose 30 cents to him in the form of an International Money Order.—EDITOR].

Another Note on Mr. Cunningham's paper on the Animality of the Diatom.

By ARTHUR M. EDWARDS, M. D.
NEWARK, N. J.

I did not intend to notice Mr. Cunningham's paper in the August number of the MICROSCOPICAL JOURNAL because I did not think it worth noticing. There are enough idle papers written on microscopy and if an observer tries to answer all, his work may be endless. But it has called forth a note on the errors in practical microscopy in Mr. C's paper, from Dr. Stokes, which is published in the October number. I let that pass. I think that Dr. Stokes has pointed out the errors in a mild spirit. I cannot let the errors in way of the Diatoms pass so easily. And I wish to say something about the animality of the Diatom itself. That the Diatom is an animal, of course with Dr. Stokes *I* do not believe.

What is an animal? And what is a vegetable? And how can one state be proved more than another by any optical method? Is an animal something that takes in oxygen and gives off carbonic acid? Is a vegetable something that takes in carbonic acid and gives off oxygen? And what are those things, the fungi for instance that do neither? And can one organism be proved an animal or a vegetable by optical powers? I think not. Now I do not wish to attack Mr. Cunningham personally, for personally he is my friend, but I do wish to attack his theories as to the animality of the Diatom. No optical appliance better put together than his impossible contrivance will be sufficient to prove or make others see that the Diatoms are animals. I mean the Bacillariaceæ. For that is the whole individual,—be it animal or be it vegetable or be it protiston. The Diatom is the siliceous shell of a prepared Bacillarian. Bacillariaceæ are not vegetables and are not animals, but are something having animal and vegetable properties,—in short protista.

THE MICROSCOPE.

New Series, 1893.

For Naturalists, Physicians, and Druggists, and Designed to Popularize Microscopy.

Published monthly. Price $1.00 per annum. Subscriptions should end with the year. The old series, consisting of 12 volumes (1881–1892), ended with December, 1892. Sets of the old series cannot be furnished. All correspondence, exchanges, and books for notice should be addressed to the Microscopical Publishing Co., Washington, D. C., U. S. A.

CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

Made an Assignment.—The announcement that any business firm has suspended carries with it a feeling of regret. There is not, however, surprise in a case like that of Queen & Co., considering how they have tried to do business in recent years. Frequently there have come to our notice reports of peculiar doings, which we have regretted to hear and have refrained from publishing.

Only a few weeks before the assignment, they asked if we would send out their "clearance sale" list of second-hand and shop-worn goods with every copy of our periodical. To do so would be an infringement of the postal laws regarding second-class matter and we promptly declined to do it. To pay fourth class postage on our entire edition would have cost them much more than a legitimate advertisement.

Personal.—W. P. Manton, M. D., formerly an editor of this periodical, has published a Syllabus of Lectures on Human Embryology. It is for medical students and practitioners, and contains 70 drawings and photo-engravings.

We hope that Dr. Manton will sometimes favor us with contributions in spite of his very buisy life and practice.

Pure Food.—At the recent Pure Food Exposition in this city, our friends of the *Popular Health Magazine*, gave a series of demonstrations Microscopic and otherwise which atracted much

attention. Drs. Thomas Taylor and Theobald Smith rendered assistance. F. W. McAllister and G. T. Sadtler's Sons loaned some microscopes for the purpose.

QUESTIONS ANSWERED.

NOTE.—*Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of all grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.*

206. *How can I breed eels in paste, for use under the microscope? —Inca.*

Add some old vinegar containing eels to cold, boiled flour paste. A sample of paste containing eels may often be found in a bookbinders paste pot.

207. *Where can I get a work on Bacteria that will give illustrations similar to those in the March Microscope, but enlarged so that I can make out the cell walls?—S. A. K.*

Sternberg's Manual of Bacteriology, published by Wm. Wood, Co., price $9,00, will probably supply your needs.

208. *Can you give a good and easily prepared stain for tubercle bacilli?—C. F.*

The Ziehe Carbol-Fuchsin is a good formula:

Fuchsin (Magenta),	1 part.
Alcohol,	10 part.
Solution carbolic acid in water (5 per cent)	100 part.

Mix and filter. This solutions will keep well. Stain the sputa about 5 minutes cold, or half that time if warmed. Clear up the diffuse staining with a 5 per cent solution of sulphuric acid for ½ to 1 minute.

209. *What is meant by "immunity," or cures produced by injections of something?—J. A. B.*

Immunity is a protected condition resulting from a first attack of a disease, like small pox or measles. A more or less complete immunity is produced by inoculation with cow pox virus, to protect from small pox. At present an animal, say a goat or a horse, is repeatedly inoculated with a pure culture of

tetanus or of diphtheria, commencing with a minute quantity, until a condition of "tolerance" is produced, which will resist an ordinarily fatal inocultaion. The blood and serum of the animal then contains an *antitoxine* which in some way, not yet understood, protects it against further infection. This serum injected into another animal, confers upon the same immunity or resistance. This serum is being used, by injection with a hypodermic syringe, in cases of diphtheria, and it is reported to have materially reduced the death rate in that disease.

PRACTICAL SUGGESTIONS.

By L. A. WILLSON,

CLEVELAND, OHIO.

Fresh Mounts.—Fresh mounts should be placed in trays and kept horizontal until the mounting medium and the rings used have hardened. *Always place a slip* upon or under the slide, containing the name of the object. If this latter suggestion be disregarded, it is surprising how soon the name of an object can be forgotten and the mount thereby rendered useless.

How to Obtain Foraminifera from Chalk.—The following is probably an improvement on the methods usually given in books. The chalk to be used must be native chalk, the sticks of chalk used in schools is ground and prepared and will not answer the purpose. Carpenters chalk is native unprepared chalk.

Boil some fragments of chalk in a strong solution of Glaubers Salts (Soda Sulphate) set aside to cool and crystallize. This separates the chalk into a powder, then by repeated washings and settlings, the salts and the light fluffy debris are washed away and perfect shells obtained in the sediment.

Preservation of Algæ.—Algæ keep well and preserve their color when mounted in a solution of hydrate of chloral. The following is also a fine medium for this purpose. Camphorated water and distilled water each 50 grammes, glacial acetic acid, .5 grammes, crystallized chloride of copper and crystallized nitrate of copper, of each, .2 grammes, dissolve and filter.

Fixing Objects to a Slide.—In arranging diatoms, spicules,

butterfly scales, etc., etc., many a slide has been ruined and much patient labor wasted by attempting to cement the object to the slides with common mucilage. The following recipe will afford better and more satisfactory results.

Selected pieces of gum Arabic are dissolved in distilled water so as to form a thin mucilage. This is filtered, and the filtrate poured into a considerable volume of alcohol, which precipitates the arabin. This is separated from the mother liquor by filtration washed with alcohol and finally dried.

For use, dissolve a small portion in water and apply a thin film to the slide with a camel's hair brush. As each diatom or object is mounted, gently breath upon it and the moisture will fasten it to the slide.

Crystal slides.—Make a cold saturated solution of a salt; then heat the solution so that it will dissolve still more of the salt. A cell is then filled with the warm solution, and immediately sealed. Upon cooling, the crystals will be deposited within the cell in a most beautiful manner, and their lustre will be retained. Gold size is a suitable cement for slides prepared in this manner.

SCIENCE-GOSSIP.

A Comple Set.—One of the very few men who have complete sets of *The Microscope* and *Microscopical Journal* from 1881 to date, is Dr. E. F. Hodges, of Indianapolis. He also has the Journal of the Royal Microscopical Society complete. These sets are of great value for reference and when sold command a high price.

Fermentation.—Evening classes for the study of fermentation are to be held by Prof. F. W. Fellowes, 61 Chancey lane, London. There will be six weekly lectures of especially interest to brewers, bakers and analysts, with practical demonstrations.

Fruit Skins.—The bloom of a peach is a luxuriant growth of microbes. All fruit skins carry germs and so should never be eaten. for the stomach may enable them to multiply indefinitely especially in old or feeble persons.

Microscopical Praxis.—This is the name of Dr. Stokes' new book, just issued. It will be of much assistance to the student.

THE MICROSCOPE.

Contents for November, 1894.

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Contents for October, 1894.

THE EXCELSIOR MICROSCOPE BOX

THE EXCELSIOR MICROSCOPE.

THE MICROSCOPE.

DECEMBER, 1894.

NUMBER 24. NEW SERIES.

A Microscope for Children.

By CHRYSANTHEMUM.

WITH FRONTISPIECE.

There is no good reason why boys and girls should not early commence the use of a microscope and derive great pleasure and instruction therefrom. We shall be glad to help interest young people in the beauties which are just beyond their sight, to create a love for natural science, teach them carefulness and observation and thereby furnish instructive enjoyment for many leisure hours. They can examine common objects, such as the house fly, the butterfly, the ant, spider, honey bee, garden and flower seeds, pollen grains, etc. We can tell them the best ways of seeing things, the most interesting parts to study and also give curious or instructive facts concerning them. We shall next year give some illustrations of the objects to be studied and point out the different parts so that the beginners may know just what to see, and how to show their friends some very interesting things. Subscribers have the privilege of sending in objects or may describe to us what they have found of interest. For this work any simple microscope or low power compound microscope may be used. There is a convenient little dissecting microscope, which will always be of use even if one has a larger instrument, and which we shall describe. It is shown in the frontispiece. We shall give some directions for seeing the objects that can be studied with this instrument, so that

a boy or girl of ten or twelve summers may soon learn to find much enjoyment with it.

This instrument consists of a small wooden case the exact size of that shown in the engraving. To one end of the lid of this box is attached one of the ends of the box and when the lid is reversed and turned upside down it may be slid into the groove of the case and then it forms a stand for the lenses, F, and glass stage, G, as shown in the large figure. The lenses and stage are supported by the steel rod D, the lower end of which is hinged to the lid, so that it may be turned down into the groove provided for it. The glass stage G, which is fitted to a frame of hard rubber, slides easily on the rod D so as to be readily adjustable for focus and can be fastened at any desired height by means of a set screw. This glass stage is set in such a manner that when reversed it forms a cell for holding liquids. In this cell aquatic animals may be examined at leisure. The frame that holds the lenses fits to the top of the stem. A mirror, H, is fitted to the box and is easily adjustable, by means of the button shown on the outside, so that the light may be reflected up through the stage when a transparent object is to be viewed. When it is desired to use reflected light a dark ground of hard rubber is provided which is carried by the stem D. The lenses are well made by one of our best optical firms, are three in number and so arranged that they can be used singly or together, their magnifying power varying from five to thirty diameters. They are provided with a proper diaphragm which secures distinctness of vision. If very carefully adjusted the corpuscles may be distinguished in the blood of a frog.

This instrument sells for the very low price of $2.75, but in order that many young people may become interested in microscopy we will for $2.75 send them THE MICROSCOPE for 1895 and one of these instruments, which

is equivalent to presenting them with a year's subscription if they buy one of these splendid little instruments. The instrument will go direct from the factory to the subscriber in a nice little box and is guaranteed by the maker to be in perfect order.

Whoever can get us five new subscribers prepaying one dollar each for 1895 will receive one of these microscopes as a premium free of all cost. The name of this instrument is the Excelsior Microscope.

Aquariums for Microscopists.

By M. J. TEMPERE,

PARIS.

Translated from *Le Micrograph Preparateur*.

For nearly eight years, I have had upon two of my tables, one facing the North and the other the West, half a dozen small aquariums, in four of which, water has not been completely changed but twice, and in the two others but four or five times during that period.

I have noted from time to time all the different microscopical organisms which developed in them and of which the number amounts to almost three hundred. Considering the years and especially what I have occasionally introduced in them, I have been able to grow certain organisms in quite an important quantity and in the best possible conditions.

The number of species of Diatomaceæ, of filamentous Algæ, of Desmidiaceæ and of Infusoria were greatest; then come the Larvæ, the Worms, the Entomostraca, etc.

The pleasure and interest which can be found in following the developement of such a great number of interesting objects, cause me to believe that many of our readers will try to do as I have done. As will be seen, nothing is easier. My aquariums contain—one a litre and the other half a litre. They are simply right-

angled tanks of glass which are used for making certain electrical piles.

I prefer that kind of tank to the cylindrical ones, because they facilitate observation. Many organisms adhering on the inner side develope there more uniformly and light strikes them in a more equal manner.

To commence these aquariums, after rinsing them well they should be filled three-quarters full with fountain or river water as pure as possible. The gatherings made in a pond or any pool whatever may consist of the washings of floating leaves of potamogeton, of neuphar, of stems of typhlina, of scirpus or of any other aquatic plants of that kind; or, of a certain quantity of water from the pond or the pool itself. This should be taken in a spot where many organisms have been seen in suspension. Even a small portion of these floating masses which are frequently found at the surface of water may be taken. Oftentimes, these contain quite a number of different things. Then, in each vase, should be placed one or two stems of a small aquatic plant, such as Nitella, Elodea canadensis, Callitriche aquatica, Ceratophyllum demersum, Pilularia globulifera, some Lemnia and one or two small-sized mollusks, 6 or 8 millimetres long.

The orifice of the vases must be covered with a simple pasteboard of the form of a box-cover wide enough to let the air go in without admitting the dust. The aquariums thus prepared are then placed in a lighted place but well out of the sun's rays. About every fifteen days, a little water is added in order to offset evaporation. That is very important. The water is added slowly and dropped on the side of the glass, so as not to disturb the water of the aquarium.

During all the year, even in winter, the presence of living and numerous organisms will be noticed, but it is especially from August to November when the surprises will quickly succeed each other.

The height of the tallest of the tanks of which I have spoken being but 16 millimetres, it is easy to raise the objects which it is desired to examine with a pipette provided with a rubber bulb.

I will speak, in the future, of the special cultures that can be made with these aquariums. Meanwhile I shall be much pleased to hear from some of our readers who have tried and succeeded.—Rene Samson.

A Newly Discovered Cause of Typhoid Fever.

Recently the College communities at Amherst and at Wesleyan University were startled by the development of a considerable number of cases of typhoid fever. In response to an inquiry addressed by us to H. W. Conn, Professor of Biology in the latter College, we have received the following statements which show what the microscope can do in combatting this disease which is to be so much dreaded:

First. We have had quite a number of cases of typhoid here. I say have had, for although several are still sick, there have been no new cases for two weeks and as you will see, we have reasons for not expecting more.

Second. The wells were of course suspected and their use immediately stopped, but investigation showed that they were not the cause, for at least three reasons. Several of the sick men had not used the wells, towns people used them freely and have not been sick, and bacteriological study showed no pathogenic germs in the wells.

Third. We have found that all cases are in *three* fraternities (with explainable exceptions) and have *demonstrated* that the cause of the trouble was a lot of raw oysters which were eaten on October 12, at the initiation suppers. These oysters came from a creek where they had been allowed to lie within three hundred feet

of the outlet of a sewer, and at the time the oysters were collected there were two cases of typhoid fever within a few feet of the creek pouring their excreta into the sewer. All these facts together have demonstrated that the trouble was due to these oysters. Oysters from the same place went to Amherst and produced a number of typhoid cases there. All our cases appeared within three weeks of the initiation suppers, and none of our young men suffered that did not eat these raw oysters. I will not attempt however to give you all the details now. They will be published later.

Doubtless it may be a disgrace to have typhoid but in this case it was a disgrace of ignorance on the part of the oyster planters who had no suspicion that any evil results would acrue. I think you will see that it is not the fault of any one here at Middletown for it is unique to find typhoid thus traced to oysters.

We are much pleased to know that our Alma Mater has so capable a bacteriologist in its employ and are especially gratified to know the dangers attendant upon eating raw oysters. In a few years, typhoid and many other zymotic diseases will have come under as complete control as is small pox. Suspected oysters may now be tested for typhoid germs and their presence clearly demonstrated, but many more people should learn how to do such work and become guardians of public health.

Railroad Microscope Stage.—A simple and elegant form of microscope stage has been devised by Mr. J. P. Swift, of 81 Tottenham Court Road, W., London, the adjustment depending upon the principle of the friction-roller, instead of that of the gear-wheel, or screw. The friction-rollers, whereby the carriage is moved backwards or forwards over the table, are provided with milled thumb screws. Obviously the adjustment is one of great precision and simplicity.—*The Optician.*

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New Series, 1893.

For Naturalists, Physicians, and Druggists, and Designed to Popularize Microscopy.

Published monthly. Price $1.00 per annum. Subscriptions should end with the year. The old series, consisting of 12 volumes (1881–1892), ended with December, 1892. Sets of the old series cannot be furnished. All correspondence, exchanges, and books for notice should be addressed to the Microscopical Publishing Co., Washington, D. C., U. S. A.

CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

Primary Dissecting Microscope.—Manufactured by the Bausch & Lomb Optical Co., Rochester, N. Y. This Microscope was designed by Prof. C. R. Barnes of the University of Wisconsin and has been in use in their and other laboratories for several years with very satisfactory results. It is a most effective and low priced dissecting instrument.

The body is a solid block of wood so shaped that the sides serve as hand rests. The advantage of this is that the block practically forms a part of the table on which it rests and is then very steady to work upon. Mirror and movable glass stage are provided for in a very simple manner. The lenses are carried in an arm, the post of which slides in a metal sleeve, thus allowing the entire stage to be covered and giving sufficient rays and accuracy of focus. A square plate black on one side and white on the other is arranged to slip under the stage for dark or white ground. A groove on the lower side of the block receives the plate when not in use.

Clark's Book for Beginners.—We call attention to this book again in order to offer it as a premium for two new subscribers.

One wholly unacquainted with the microscope may, by following the simple, clear, and concise directions, be sure of reaching successful results. The processes have in all cases been simplified as much as is consistent with good results. Re-

gard has also been paid to the expense of apparatus, and the processes are adapted to apparatus of the minimum cost.

Features of the book are: the clear statement of the principles of light as they find application in the microscope; the discussion of polarized light, a subject of considerable practical importance, but one that is often inadequately treated in the books on the microscope. The detailed descriptions of the processes necessary for the preparation and examination under the microscope of the various classes of objects that are to be studied in the different branches of science usually pursued in secondary schools, are interesting and attractive.

QUESTIONS ANSWERED.

NOTE.—*Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of all grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.*

209. *Where can I obtain literature bearing directly on paraffin imbedding?*—Chambliss.

We can supply you with any of the following:

American Monthly Microscopical Journal, March, 1893, pp. 75-6.

Microscopy for Amateurs, pp 19-20, 25 cents.

Modern Microscopy, Cross & Cole, p 72, $1.25.

Practical Methods in Microscopy, Clark, p 108, $1.60.

Medical Microscopy, Wethered, p 60, $2.50.

Botanical Technique, Humphrey, p 31, $3.00.

210. *My query, No. 202 in the October number of the Microscope, was not precisely answered. I refered particularly to the Wenham microscope stand. Is such a stand manufactured?*—R. Rich.

The Wenham stand is manufactured by Ross & Co., London. It is an old style instrument, complicated in form, and intended to facilitate the use of very oblique light on the object. Modern high-class objectives have made such a stand unnecessary.

211. *Can you give me a simple method for Mounting Starch.*—G. Dalton.

The starch must be perfectly dry and crushed to a fine pow-

der, if at all lumpy. Take a clean glass slip, place a very small drop of liquid balsam on the center. Let some of the fine starch fall into the balsam from the point of a knife. Set the slide away for 24 or 36 hours, covered from the dust. When the balsam is slightly hardened, shake off the surplus starch, drop a little fresh balsam on the hardened mass, put on a cover-glass. Place a weight or clip on the cover and set aside to harden completely. The first or hardened drop of balsam will soften slightly and spread uniformly carrying with it the starch. Two specimens of starch may be thus mounted under one cover for comparison and be kept separate.

212. *I have just come into the possession of a microscope, but know very little about its use. How may I best become an expert with it?—REV. J. J. Z.*

Clark's Practical Methods in Microscopy, published by Heath & Co., Boston, will teach you how to use the microscope and how to prepare objects for microscopic examination.

213. *I have a full line of Zeiss objectives and a Photomicrographic outfit. What is the literature of the subject and what dealers in supplies do you recommend?*

The A. M. M. J., for 1886 contains a very full continued article by R. Hitchcock. The volumes for 1890-91 and '93, also contain valuable articles on Photomicrography. Clark's Practical Methods in Microscopy, contains a practical article on the subject. Supplies may be had from any good dealer in photographic supplies. See our advertising columns.

PRACTICAL SUGGESTIONS.

By L. A. WILLSON,

CLEVELAND, OHIO.

How to Mount Objects in Motion for Examination by Polarized Light.—Use a rubber cell 1-16 of an inch deep and 3-4 cover. For a medium, use Canada balsam thinned with not quite an equal bulk of spirits of turpentine. Stir well together and when dissolved filter through cotton. Cement the cells to the slide with something not acted on by turpentine—for example, shellac, or sealing wax in alcohol. The objects

may be little fresh water oysters, quartz, agate, sand or any object that polarizes and does not dissolve in turpentine. The objects are kept in motion by reversing the slide. Such slides are novel and entertaining and nearly always excite the wonder and admiration of friends.

Ceratium.—This animal is a flagellate infusorian. It is in the form of a hard shell with a long sharp peduncle and three horns or processes at the top. The animal lives encased in the shell and communicates with the outer world only by means of its flagellum. It is pictured in Dallinger's Carpenter, 7th edition, on page 696. Also in the Century Dictionary, Vol. 1, page 894. At certain seasons, it is found in great numbers in the filterings of water of the Great Lakes. The most interesting feature of the animal is its flagellum. This is easily seen by an ordinary quarter-inch objective. To observe it requires no staining or manipulation.

If a quarter-inch objective fails to reveal the flagellum, it is because it has been drawn in by the infusorian. The animal seems to be timid and the least disturbance will cause it to retract its delicate flagellum. It is best to examine the Ceratium when first gathered as it seems to be very delicate and easily killed.

Opaque Slides with Asphalt.—Place an ordinary glass slip on a turn table and turn a ring of asphalt and fill the interior of the ring with the same substance. Remove from the turn table and burn the asphalt side of the slide over an alcohol lamp. After turning, immediately apply another coat of asphalt and burn again as before. While hot, place a cover glass within the ring and trim the edges with turpentine.

Cells made of a Button.—Procure a rubber button with a rim; drill out the interior containing the holes and leave a flange for the cover glass to rest upon. The edge of this flange will protect the cover. Buttons may be obtained that will exactly fit a 5-8th cover. Fasten the ring to the slip with balsam or with any kind of cement. If the circle be too large for the cover fill it with a drop of asphalt. Very beautiful cells can thus be obtained.

CORRESPONDENCE.

A Reply to Dr. Alfred C. Stokes' Critical Communication, headed "A Note incidently in regard to the Animality of the Diatom, but especially to Mr. Cunningham's method of illumination.—I have duly noted an article under the above caption published in the Oct. number of this periodial coming from the pen of the distinguished Micrographer, Dr. Alfred C. Stokes. Its appearance, as well as its constrution has all the portentiousness of a thunderbolt hurled from Jovian heights.

In a more concise vein of thought, and more to the point; Dr. Stokes' article in my opinion does not rise to the dignity of legitimate criticism; but is more properly that form of critical composition characterized as a "diatribe," for which there is neither excuse, pretence or justification; as based upon anything occurring in my article. Every point that he was pleased to find fault with has been reasonably met in my article; by implication at least, if not in a more cursive manner, and my failure to make some reference to a Homogeneous Oil immersion lens, and chip in a little about the "critical illumination," ought not to indicate on my part any real ignorance of the system of lenses, and illumination more particularly adapted to the study of recent Bacteriology. What Dr. Stokes proposed to substitute for the methods used by myself and suggested by me to others; belongs more to the limited number of workers who provide themselves with either Apochromatic; or Oil immersion lenses to be used more particularly for special purposes, such as the resolution of the most difficult tests, Amphipleura, &c., and when this stage is reached they are often happy and contented in the possession of lenses, of which occasionally a possessor of one ostentatiously announces its angle, resolving power, &c., which sends a wave of envious desire pulsating over the microscopical horizon(?) I might have felt the sting of the want, if it had not been that in a former day, I had received directly from Carl Reichert's own hand, one of his 1-15 inch., Homogeneous Oil immersion lenses, with its appropriate hemispherical immersion illuminating lens to be applied directly in contact with the slide. A record of its use and application in the study

of a preparation of a slide of selected diatoms derived from the surroundings of Mobile and containing some 1500 diatoms, representing many species, was duly referred to in an article entitled "Diatomology," in the A. M. M. J., for November, 1892, under my name. This statement should free me from the charge of indifference to the use of the highest powers and most costly lenses. And on the principle that "enough is as good as a feast," one usually adapts the character and quality of the optical appliances to the nature of the work to be done, or the problem to be solved. This latter choice or preference is essentially what was done in and during the studies leading to the results recorded in "The Diatom considered as a Protozoan," and as the directness of the methods, as well as the relatively simple optical requisites are available to all who have the use of a compound microscope, there need not be any fear of failure to verify all, or some, of the "fine points" as outlined in the article previously named. That form of critical acumen which attempts to wipe out, at a single stroke of "snap-judgment;" and the *ipse dixit* style of decision in disposing of facts and phenomena, fairly obtained through patient, persistent, and intelligent study, and seriously communicated to those interested in science, ought never to find "aiders and abettors."

The unselfish pursuit of science is largely for the establishment of "truths" in all branches of human enquiry, and the consequent eradicating of error, and this is the rule of conduct that guides me.

As a contrast, and to offset the baneful influence of my "American joke" on Dr. Stokes, I take the liberty to state that the article entitled "Studies in the Biology of the Diatoms" in the July Am. M. M. J. secured me a correspondent from Sheffield, Eng., whose initial, and subsequent letters contained complimentary expressions, sufficient to amply compensate for the cold-water *douche* administered by Dr. Stokes and as a result, this correspondent has consented, at the invitation of the Editor of the A. A. M. J. to contribute to the American Journal, recent researches appertaining to the Biology of the Diatoms, which paper, would have eventually appeared in the Journal of the Royal Microscopical Society, and when they appear, the readers will have to thank Dr. Stokes for the success of his double back-action and hammerless critical note, which made the

situation possible. In conclusion, I would invite all interested in the Diatoms, to make the trials, tests and verifications for themselves, before condemning or criticising too harshly the methods which in a moment of unsophisticated thought I deemed worthy of publication.

For sixteen years I have been a reader of one or both of our Journals devoted to Microscopic Science, and of The Microscope during Dr. Alfred C. Stokes' editorial management of it. I had learned to appreciate the brilliant, but somewhat impetuous style of his editorials, and later of his Biological contributions. I envied the facileness of his pen. But when struggling genius spreading its pinions for a trial flight, is rudely struck at, it does not expect to see a friend in exultation.—*K. M. Cunningham.*

On the Animality of the Daitom.—Mr. Cunningham sends us the following which he has received relative to his late paper:

I take the Amer. Mo. Micr. Jour. and had therefore seen your second article which contains much that is of interest to me, although I have not had any reason so far to differ from the views of the Rev. W. Smith and the numerous other diatomists who have followed him in regard to the plant nature of the Diatom. I think it foolish of anyone to be dogmatic on the subject and to refuse to allow those who follow Ehrenberg in considering the possibility of it turning out to belong to the Protozoans to show cause why the question should be re-discussed. I can entirely and positively confirm your observation of the power of the Diatom to move rapidly objects of various size along its surface. Three weeke ago I had the pleasure of observing with a Nachet's 1/8, the comparatively small Navicula radiosa rapidly move a mass of mucous matter of at least a fourth of its own size in which a number of minute grains of sand were embedded, backwards and forwards from extreme end to extreme end of the surface of the frustule (valvular or side view). I counted thirty return journeys of the load during which time the diatom itself was moving about in a very active manner, and the journeys which never ceased for a second while the diatom was in sight would have apparently been continued had not the load been got rid of by the diatom entering a thicket which caught the traveller and relieved the diatom of its burden. Although simple and plausible, I do notbelieve in the en-

dosmose and exosmose theory as sufficient to account for the many and curious variations of movement which I have observed among the diatoms.

I received a card from the Editor of the A. M. M. J. asking me to send him a communication upon the subject of the Biology of the Diatom, and although I had half promised what I am now engaged upon for the R. M. Society's Journal, I am tempted to accept his offer to take part in the interesting discussion in his columns.

It so happened that when on reading your article in the A. M. M. J., I wrote to you asking where I could obtain Prof. Smith's paper from which you had quoted, I had got half through an article illustrated by numerous drawings with the camera lucida, in which I sought to show that my own recent observations tended to throw doubt upon Dr. Miquel's contention in "Le Diatomiste" and to somewhat strengthen Count Castracane's objection to the theory that what since the Rev. W. Smith's time has been generally regarded as a sporangial frustule which is destined to perish after fulfilling the duties of a spore case, is in fact a simple process of nature which takes place for the purpose of the recovery of the size of the diatom diminished to its minimum as a life supporting body by repeated subdivisions. The phenomena which I considered as opposed to the size recovering theory, and as supporting the spore theory were shown very clearly in a gathering which I made last spring and from which I had mounted several dozen successful slides from which my drawings were made. They consisted of (1), many cases of formation of mega-frustules from many sizes of parent frustules of cocconema, there being many specimens of frustules of the same species in the gathering of zies considerably below the size which produced the mega-frustule and which Dr. Miquel speaks of as the minimum size which necessitates the auxospore and (2) many hyaline cysts in the same gathering as that in which the formation of the mega-frustules are so numerous which cysts apparently perfect and unbroken enclose, in many instances closely packed together numerous frustules of almost every size down to the most minute of Cocconema and Gomphonema mixed and unmixed and free from all extraneous matter. Prof. Smith's mention in his paper of a similar observation by himself (he curiously enough saw

the same mixture of Cocconema and Gomphonema as that seen n my own slides) and his ingenious explanation of the phenomenon by the vagaries of a rhizopod resembling Actinophrys sol has much impressed me, the more so as I have myself witnessed this creature's curious attack upon the contents of individual frustules, and .its emergence therefrom in the shape and with the rays shown in Prof. Smith's drawing, but I am not yet satisfied that the cysts of which I have got many perfectly clear examples in numerous other species are purely imaginary!

Prof. Smith admits the difficulty of accounting for the many minute frustules which abound in most mixed gatherings and which bear close resemblance to the different species of normal size in the gatherings. However, his paper has made me pause and I am making further and more exact observations of my cysts and their contents before writing further.—J. NEWTON COOMBE, Sheffield, England, October 11, 1894.

SCIENCE-GOSSIP.

Detecting Blood.–A chemical authority states that he has discovered a method for detecting blood stains that the microscope has failed to reveal. When the smallest drop of blood is mixed with fifteen grammes of distilled water, and one or two drops of tinture of guaiacum added, a cloudy precipitate of resin is yielded, and the solution becomes slightly colored. When there is further added to it a drop of etherial solution of peroxide of hydrogen, a blue color appears, which becomes deeper and deeper on exposure to the air.—*Science Siftings.*

RECENT PUBLICATIONS.

Transactions of the Hertfordshire Natural History Society. Vol. VII, parts 8 and 9. John Hopkinson, Editor.

We have recently received from the Society a copy of these proceedings which are issued once in two months. They are beautifully illustrated with photo-engravings and contain many interesting papers on general natural history. The excursions to points of interest form an interesting feature of the society's work. We ought to do more of such work in America.

Contents for December, 1894.

THE MICROSCOPE INDEX.

COMPILED BY HANS M. WILDER, PHILADELPHIA, PA.

LIST OF ILLUSTRATIONS.

THE MICROSCOPE.

AN ILLUSTRATED MONTHLY DESIGNED TO POPULARIZE THE SUBJECT OF MICROSCOPY.

Edited by

CHAS. W. SMILEY, A. M.

VOL. III, NEW SERIES. (NOS. 25-36.)

1895.

Published by the Microscopical Publishing Co.
Washington, D. C.

THE MICROSCOPE.

JANUARY, 1895.

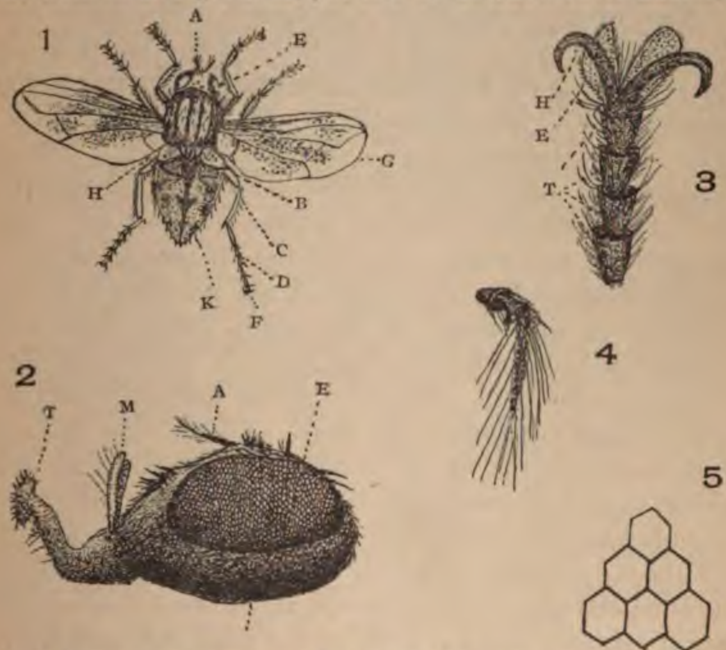
NUMBER 25. NEW SERIES.

Objects Seen Under the Microscope.

BY CHRYSANTHEMUM.

XIX.—THE HOUSE-FLY.

There are many kinds of two-winged flies which frequent our houses and gardens, yet few of us know their names,



their habits or how wonderfully they are made. Once we take the trouble to examine minutely these little insects, the humblest or more common, we shall feel that

we have made a new acquaintance and ever after when we see one of them in house or garden we can say: "Now I know you." These two-winged insects belong to the class Diptera which is composed of twenty-eight families. The house-fly, the blow-fly, the horse-fly, the mosquito and others with which we are familar belong to this class.

The little house-fly (Fig. 1) is called *Musca domestica.* But it is now midwinter and where shall we find a fly? Go to some place where meat is sold or to some out of the way hiding place. A last summer's fly may still be clinging to a spider's web or to the wall. If not dead, kill it by putting it in a large-mouthed bottle containing a little chloroform.

Now open the Excelsior microscope described in the last number and arrange it as shown in the Dec. frontispiece, placing the flat side of the glass stage G up, and the smallest of the lenses F nearest the glass stage. Put the instrument near a window with the mirror toward the light; turn the two largest lenses so they will come directly over the mirror and put the case containing the small lens and the diaphram at right angles to the lenses so that it will not interfere with the moving of the screw in the stage. Now slant the mirror so that on looking through the lenses you will have a white field. Place the fly on the centre of the glass stage, as though he were walking, and having loosened the screw in the stage, move the stage up and down very slowly until you can see the fly distinctly, and then fasten the screw. This is focusing the instrument. As the fly is quite thick and the light comes to a focus at one point only, you will not be able to see all parts with equal distinctness, but look at the head and back first, then focus again for the legs. With a little patience and practice you will be able to get a good focus quickly.

To have a microscope well lighted and in proper focus

is of the greatest importance. If the stage does not move easily, remove the parts from the rod and wipe the rod with an oily cloth, being very careful not to soil any of the parts, especially the glass. If any thing should soil the lenses wipe them with a clean, soft linen handkerchief, kept especially for the purpose, for a scratch on the lens would mean a line across every object seen through it ever after. There is one difficulty with this little instrument,—it is so light that it moves easily and disarranges the object. To obviate this take a piece of smooth board four inches by six and an inch thick and with one little screw fasten the case to the center of the board. This will make it quite firm. As the fly is an opaque object, if your light is strong sun-light, you can use the dark background which should then be turned so as to hide the mirror but better results can be gotten with the mirror turned so as to show a light field but not a bright one. The fly will be magnified about thirteen diameters. We will first learn the position of each of the parts, separately.

The redish brown spots on either side of the head (Fig. 1, E) are the eyes. Between the eyes the head is covered with short yellowish and black hairs and just at the front of the head are what look like two tufts or long black hairs. These are the antennæ (Fig. 1 A). The head is joined to the body or thorax, by a very short neck, and, if you watch a fly, you will see that he seems to have the power to turn his head quite around. The thorax is covered with the yellowish and black hairs in stripes, and to this are attached three pairs of legs, two wings and the abdomen.

Now move the stage up a very little so as to bring the legs into focus. These consist of several joints. There is one which joins the body and that we do not see called the *coxa*, next comes the *femur* or thigh,

B, then the *tibia* or shank, C, then the *tarsi*, D, (these are small joints just above the foot,) and the foot, F, which shows two little hooks. In securing the fly some of the parts may have been destroyed or they may be in such a position as to be hidden by some other part, so it is well to look at several until you can tell each part readily. In this position the tongue or proboscis is not visible. In order to see this, place the fly upon its side. At the front of the head just below the antennæ will be seen the tongue, if it is extended. Fig. 2 is a sketch of the head of a fly with the tongue, T, very much extended. It does not often show as much as this. The figure also shows the palpi.

Take all three of the lenses together using the little diaphragm and place the fly on its side with the head on the center of the stage and the tongue towards the light, move the stage up very slowly and when there is a good focus, fasten it. The object seems now much nearer to the lens than before, this is due to the higher magnifying power which is now about thirty diameters.

The diaphragm is used to shut off a part of the light so as to show the object more distinctly, and it makes the field smaller. Now look at the redish brown oval spot, (Fig. 2 E) and you will see the little hexagonal lenses of which there are 2000 in each eye, arranged very much like the cells of the honey-comb, (Fig. 5.) These are the parts of the compound eye and are each connected with the nerve of sight. Each part of this compound eye is so arranged as to form a perfect picture. Carpenter in his work on the microscope (page 908), gives a picture taken through one of these compound eyes. At A is one of the antennæ or feelers. This is composed of joints and by their number, shape and position, the genera and species of different insects are distinguished. The antenna of this fly has three joints, Fig. 4, but the first two are so small and near the body

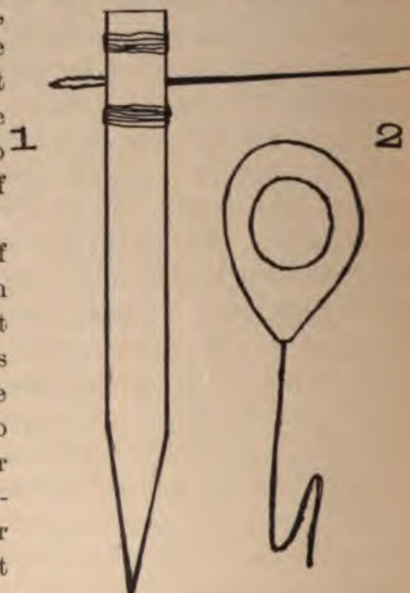
that we cannot see them. The last joint is covered with long hairs. An organ has recently been discovered in the antennæ of some insects which is thought to be the organ of hearing.

The tongue, (Fig. 2 T), is a broad fleshy lobe which is crossed with spiral fibers by which the fly is able to suck the juices it feeds on. There are little short stiff hairs set around the base of the tongue. It is these by which we are so much annoyed. M indicates the palpi. These correspond to the instrument that the mosquito uses to pierce the flesh of his victim when he seeks blood.

Move the fly so as to show his wings. If these are at the right angle they will show beautiful iridescent colors. Notice the veins in the wings, as their arrangement is important. Compare these with the wings of other insects. See along the outer edge of the wing the little row of hairs, then the beautiful net work of veins and in examining the wings of different flies, notice that the larger the fly the stronger and more numerous the veins. The wings of the *Musca domestica* make 600 strokes in a second, which carries it five yards and if alarmed it can fly thirty feet in a second. The veins in the wings we are told are hollow air vessels which communicate with the lungs, for even the little fly has lungs and an organ which acts as a heart to send the blood throughout his body and into his wings. He has also an alimentary canal, salivary vessels, biliary tubes, and a chylific stomach which seems to supply the whole alimentary canal with the power of digesting food. Flies have a crop or gizzard which is used chiefly as a reservoir for food when the insect takes more than it needs for its immediate wants.

The legs.—Take one from the body and arrange so as to see the foot. If you are to handle such small objects you will find a pair of pointed forceps necessary. These you can buy or make. Take two pieces of good elastic

whale-bone, three inches long and about one fourth inch in width, hold the end over the lamp and when it is warm it can be cut easily. Shape each piece nearly to a point as in Fig. 1, being sure to have them smooth at the points and of exactly the same shape. About one half inch from the other end cut a little notch in each edge having the notches exactly correspond when the pieces are put together, tightly bind the two pieces together by strong thread, putting the thread in the notches that it may not slip. Carefully bend the pieces so that the two points will stay one half inch apart.



Notice that the legs of the fly are covered with stiff black hairs and that these are quite numerous on the tarsi, and that the foot is furnished with two hooks (Fig. 3, H.) Under these hooks are two membraneous expansions or pulvilli, these are beset with hairs, and are in some way connected with its power to walk on the smooth surfaces in opposition to the force of gravity. Recent investigation has led to the belief that these secrete a gelatinous substançe, the adhesion of which enables the fly to walk on the walls and ceilings and the two hooks are used to aid in detaching the foot, as we tear off a porous plaster, and the reason the flies remain hanging to the windows in the fall is because in their weakened condition they have not the strength to detach their feet.

The flies are great scavengers, feeding on all kinds of decaying matter and noxious gases, detecting them even before we do. In this way they are a great benefit. Notice the hairs on the legs, feet and tongue, take one of last year's flies, see the particles of dust clinging to the hair. Now will not the particles from the decaying substances upon which it feeds and bacilli of diseases cling to them in the same way? It is in this waythat he caries contageous diseases and he should be kept away from our food. When the fly is seen rubbing his legs together he is using the little hairs of the tarsi to clean himself from these particles.

If the microscope is used in the evening, you may find that the object does not show distinctly. This is because it is not properly lighted. It is best to use a small coal-oil lamp, having it six or eight inches from the mirror and shading the light from the eyes by a piece of paper hung to the lamp chimney by a bent hair pin and of such length as to allow the light to fall strongly on an object. This with the mirror turned so as to show a white field will give a good outline or show a transparent object well, but it is not sufficient for opaque objects. We need a condenser—something to throw a strong light on the object only. This can be made at home by getting at the opticians a double convex lens about the size of a coat button and cutting a piece of sole leather in the shape shown in Fig. 2, having a round opening in the center. With a sharp knife, divide the leather at the round end and around the opening so as to make a case for the lens. In the small end insert a wire about four inches long bent at the other end as shown in the diagram and insert this bent end in the center of a spool.

Place this between the lamp and the mirror and by moving it or changing the height by moving the wire up or down in the spool throw the point of light directly on the object to be seen. The dark background must

now be used. This will show the colors of the hairs and the iridescence of the wings.

It is not always possible to lay the object on the stage in just the desired position, but with a pair of stage forceps it can be held in any way. These can be bought, but Fig. 1 represents a pair made of whalebone which answer for a small instrument. Cut two pieces of whalebone as for the other forceps having two notches in the end instead of one. Wind with strong thread in both notches leaving a space between them, in this space insert between the strips of bone a large darning needle. By separating the bones a very little and bending the pointed ends toward each other you will have a pair of forceps which will hold an object. Having placed the object in the forceps with the part desired up, turn aside the stage of your instrument and stick the needle in the board in such a position that the object comes under the lens. Then by raising or lowering the forceps you can get the focus. These are very useful for looking at the small parts of flowers and in examining whole insects.

Buying a Microscope.

By H. M. WHELPLEY,

ST. LOUIS, MO.

The expense of ignorance is ever apparent to the observing person. In fact, every one realizes the cost of the bitter lesson taught by experience. We were made to realize this recently when called to examine a microscope which a druggist had purchased at an expense of forty-five dollars. The owner of the instrument was obliged to depend on the judgment and integrity of the firm from which he ordered it, as his knowledge of the instrument was limited to its name. As a result the druggist exchanged forty-five dollars for a microscope that we would not pay ten for, unless it was to have a cabinet specime of different styles of manufacture.

It is just as true as it is unfortunate that the market is flooded with poor microscopes which are being sold at extravagant prices. It affords us pleasure to say that they are not the product of American industry, but are brought to this country to satisfy that morbid idea that so many have which leads them to believe in the superiority of anything that is "foreign," and to rave over an article from Paris. It is not our intention to convey the idea that all foreign microscopes are of an inferior quality, for this is far from the truth. However, it is note-worthy that the Unites States manufacture fewer poor instruments than are imported for sale here. In fact, there is no necessity or even a good valid excuse for a pharmacist purchasing anything but an American microscope.

A word of advice anent the subject of selecting a microscope for pharmaceutical work may not be amiss at this time. Students at colleges of pharmacy, and those druggists who live in cities where such institutions exist, should embrace every opportunity for acquiring knowledge of the microscope as an optical instrument. This will enable them to select the microscope most suitable for the work and within the range of their means. Do not invest less than twenty-five dollars, and if possible expend fifty or seventy-five dollars for an outfit.

Those who are so situated that they cannot become familiar with the microscope and be their own judge must depend on others for a selection. Their opticians, as a rule, are not microscopists, much less pharmacists, and their judgement is often materially strabismic from the effects of the profit influence. To them the best microscope is the one that costs them the least and sells for the highest price. It is far better for a druggist to consult some competent microscopist and place his order accordingly.—EDITORIAL IN *Meyer Brothers' Druggist*, January, 1895.

A Few Suggestions to Novices in Photo-Micrography.

By NELSON B. SIZER, M. D.
BROOKLYN, N. Y.

From various quarters appeals for help so often come, that I trust a few practical hints may not, at this time, be *mal a propos* to the many amateurs who have yet to take their first photograph with the microscope.

To such, let me repeat with emphasis: One of the most important things is, to see that the sensitive plate is rigidly secured in a position accurately perpendicular to the optical axes of the apparatus both vertically and horizontally.

To secure this essential condition, measure the length of your expanded camera in inches, which for general use, may well be a quarter plate or 5x4. Next, incline your "scope" till horizontal, and measure its length from the upper end of the eye-piece to the end of the arm that carries the mirror. Then allow, say, 12 or 14 inches for room for your lamp and condensing apparatus, and add the three measures together. The sum will be the least useful length of your base-board.

To make this most essential part of the apparatus, procure a nice piece of pine board, truly parallel, about $\frac{7}{8}$ or 1 inch thick and the width of the camera exactly, its length being decided as above.

Fasten a thin hardwood strip to each edge, projecting $\frac{1}{2}$ inch above the upper side of the board; this will allow the camera to be freely moved lengthwise but keep always its axis parallel to the edge of the base.

The camera may now be expanded and its base-board fastened firmly to the base, so as to allow the bellows to freely play, but to prevent undesirable lateral motion.

Take out, now, the "lens-board" of your camera, and fit in its place a new one, made of thin pine, or "cigar-box" cedar if more convenient. Now mark upon the new front the point opposite the centre of the plate during

an exposure, and these two points must be put in the optical axis of the objective and ocular you use. For locating this point, cut an old mount and fit it in the plate-holder, like a sensitive plate, obtain its centre point by intersecting diagonals and here make a pin-hole. Put the card-board in your holder, draw both shutters and put the holder in place, closing the bellows up as far as it will go toward the front board, and mark the new board by a long needle put through the hole in the card, and kept perpendicular to the surface of the latter. You may now use the mark on the new front as the centre of a hole to be cut for the microscope tube to enter, and to be at least twice as large as the eye-pieces to be used in it.

To connect the parts light-tight, make a conical bag of velvet or of similar stuff; the larger end too big to go through the hole in the front, and the smaller end fitted to easily go over the eye-piece of your 'scope, the length being 2½ to 3 inches. Pass the bag through the front board and tack or glue its larger end thereto, to be light-tight. The lesser end fits over the eye-piece end and is secured by an elastic band or its equivalent. This gives us a light proof but movable connection between the camera and the microscope.

To insure the coincidence of the optical axes of the two parts of the apparatus above mentioned, proceed as follows: Having found and marked the centre point of the new front board of the camera, put the microscope in its place on the board, the latter being on a table and made level accurately.

Now incline the tube of the microscope until horizontal, as shown by a small level placed thereon. Gently move your 'scope until the eye-piece end presses against a front board, on which you are to trace the outline of its circular milled flange. If you find the hole and circle central, very well; if not, the microscope as a whole must be raised or lowered until its optical axis is coincident with

that of the camera. It will facilitate things to draw a centre line from end to end of the base-board.

To insure steadiness, hold microscope rigidly in place by its base, cutting holes, if necessary, for the feet, and fastening all down by padded cross-strips of wood held by screws.

Similarly centre your illuminating apparatus and condensers, so that an eye placed at the centre of the plate could look directly through and see the ocular, objective, condensers and flame all in one and the same straight line.

To secure freedom from jarring and vibration, which spoils too many fine negatives buy three of the hemispherical rubber balls with screw attached, sold by all hardware and furniture men to screw into furniture to keep it from marring the wall and woodwork. Make legs of these, putting them in the under side of the base, two under the back of the camera, close to the edges of the board, the third at the centre of the other end. On these three legs the apparatus will stand firmly, even if the table-top, on which it is placed, may not be absolutely flat; vibrations also being absorbed, so that a passing "L" train, or beer truck will not disturb the work.

I have already referred to the joint between the 'scope and camera, and now only add, that while light-tight, it is also flexible enough to allow focussing.

Eye-pieces may be used, or not, as found best, under conditions described in technical treatises on the subject but it is absolutely requisite that every reflecting point throughout all the apparatus must be suppressed, or fog will result, as exposures are naturally somewhat prolonged. This may be well done by rubbing up lamp-black lacquer until a spot touched therewith shows a uniformly dull surface, with no reflection whatsoever when dry.

Having dabbled in such work for more than twenty years, I have met and overcome the most technical

stumbling-blocks which amateurs are apt to encounter in photo-micrography, and I find an absolutely essential point to be the keeping of all the apparatus in a straight line. Unless this is secured, the most elaborate apparatus and most careful focusing are but in vain, for otherwise, if one edge of the field is sharp, the other goes out into "fuzziness," and an even, sharp focus is a physical imposibility.

One caution. If using "apochromatics" never expect to see a flat field, for the objectionable roundness noticed in ocular observations will be doubled or trebled in a long-focussed camera. The obvious and only remedy is: Carefully put what you want to photograph in the centre of the field, and use a large-sized plate, so that you can afford to stop off the edges in printing your positives. In this way the curvature will not be offensive.—*The Photographic Times.*

An Examination for Blood.—The Bishop of Versailles, Monseigneur Goux, has submitted the famous seamless coat which is preserved as a relic in the church of Argenteuil and which according to tradition is stained with the blood of Christ, to examination by scientific experts. For this purpose he chose M. Philippe Lafon and M. J. Roussel, who were asked to furnish an answer to the following questi n: "What is the exact nature of the spots on the garment known as the Holy Coat of Argenteuil?" These experts in due course certified that they had made a chemical and microscopical examination of the "Holy Coat." After describing in the ordinary way, the tests employed, they sum up (according to the *British Medical Journal)* as follows: "From the portion of the Coat marked with rust colored spots we obtained: (1) A faint green coloration, with the tincture of guaiacum and the essence of turpentine, (2) the revival of the red globules of blood, with the artificial serum, (3) the formation of crystals of hæmin, or of chlorohydrate of hæmatin. These indications are sufficient to enable us to affirm that the spots examined are actually due to blood—and to human blood. Judging by the whole of our analysis, we presume that this blood is very old.

THE MICROSCOPE.

New Series, 1893.

For Naturalists, Physicians, and Druggists, and Designed to Popularize Microscopy.

Published monthly. Price $1.00 per annum. Subscriptions should end with the year. The old series, consisting of 12 volumes (1881–1892), ended with December, 1892. Sets of the old series cannot be furnished. All correspondence, exchanges, and books for notice should be addressed to the Microscopical Publishing Co., Washington, D. C., U. S. A.

CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

Foreign Microscopes.—On another page will be found Dr. Whelpley's opinion of foreign microscopes,—that while some very bad ones have been brought over here, there are others which are excellent, but that after all there is little or no excuse for buying imported instruments.

While publishing his views, it has seemed best to us to distinctly assure our readers that none of the worthless instruments alluded to are advertised in our columns. We are sure that our readers may trust quite fully the firms which advertise with us. We know from a personal tour through the shops of Watson & Sons, in London, that everything about their work is first-class and that they take the greatest pride in maintaining a high reputation.

Of course we desire to see home industry thrive and we believe that Bausch and Lomb, Zentmayer and some others make very fine instruments; but, dear reader, if you can get a better bargain from Watson, than from our own makers, do not hesitate to do so. Moreover, as Dr. Whelpley suggests, have the aid of a competent microscopist in deciding which is the better bargain. Let not sentiment either regarding the patronage of home products or regarding the superiority of whatever comes from Europe, have any weight with you in buying. Seek merit and a bargain.

QUESTIONS ANSWERED.

Note.—*Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of all grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.*

214. *Can you give me the addresses of Messrs. Powell & Lealand and R. & J. Beck of London, as I desire to obtain the catalogues of the above firms?*

R. & J. Beck, Manufacturing Opticians, 31 Cornh ll, London. E. C., England. Powell & Lealand, Manufacturing Opticians. London, England.

215. *Of whom can I obtain the Stephenson Erecting Binocular Dissecting Microscope, described in Carpenter's work on the Microscope?—H. L. B.*

John Browning, Manufacturing Optician, 111 Minories, London, E., England.

216. *What method will harden in the shortest time, tumors or histological material?—J. R.*

Absolute alcohol will harden small pieces of tissue in a few hours, but may produce much shrinkage or distortion. Try Fol's solution:

Picric acid. Saturated aqueous solution,	10	parts
Chromic acid, 5 grains to one oz. of water,	25	"
Water	65	"

Mix.

It will harden small pieces of tissue in 24 hours. The picric acid stains the tissues also, but other stains may be used if desired.

217. *How shall I proceed to collect and examine the impurities floating in the air of a work-shop?—E. A. B.*

The floating dust, etc., work-shops and school-rooms may be caught in this way. Prepare slips of glass by smearing a small area with glycerine. Place these slips in different places about the room during working-hours. Let them remain during the night so that the floating particles may fall upon the glycerine and be retained. Add more glycerine if necessary, cover, ring with varnish and examine.

PRACTICAL SUGGESTIONS.

By L. A. WILLSON,
CLEVELAND, OHIO.

Metallic Globules.—Very interesting and pretty slides may be made from condensed volatilized metals. Gold that condenses from the melting pots of the mint forms microscopic globules of gold. On the roof of copper-smelting works a fine black appearing dust is found which under the 'scope is shown to be globules of metalic copper and when viewed as opaque objects exhibit the light red metallic lustre of copper. Many of the globules are hollow.

Vertical Illuminator.—This accessory is of very limited utility. In the hands of an expert manipulator it will grandly show the lines on an opaque silver-plated Amphipleura pelucida and will reveal a few other opaque objects with high powers. In the hands of an amateur it is but an aggravation of spirit. It does not work at all satisfactorily with dry lenses. It is suitable only for objects mounted dry on the cover and with immersion lenses.

Daphnilla Tuckermanii.—When a filtering of water supply from the Great Lakes is poured into a glass most of the diatoms and the heavier material fall to the bottom but little specks are always found floating on the surface. The specks generally contain some of the most interesting and wonderful forms in the gathering. In this way I recently had the pleasure of obtaing this strange and complicated Crustacean. Remove the specks with a spatula to a cell, cover and examine with an inch objective. The little thing was so interestiug that I mixed glycerine with the water and mounted it permanently.

An Elegant microtome.—Possessing an old fashioned section cutter, that cost $15 some years ago, and finding that, in my hands, it was absolutely worthless for any fine or accurate work, I committed it to the tender mercies of a scientific young machinist.

He made a very heavy iron casting with a V shaped opening, into this he inserted a V shaped sliding portion for a knife carrier; firmly attached the old section cutter to the heavy casting; furnished brass screws and clamps. When a proper knife was screwed to the carrier, the old section cutter was transformed into an elegant accurate and efficient modern microtome and at a trifling expense.

THE MICROSCOPE.

FEBRUARY, 1895.

NUMBER 26. NEW SERIES.

Objects Seen Under the Microscope.

BY CHRYSANTHEMUM.

XX.—ROTIFERS.

The water of our ponds and rivers is peopled with many forms of minute animal life, and even the weeds

in a tank with gold-fish have among their branches some very interesting little animals. Take a small piece of the plant, that which looks old and brown being the best.

Put it on the stage of the Excelsior (or other) microscope, add a drop of water, and place over it a cover-glass. With the three lenses together, focus sharply. Examine the leaves very carefully and having found a little brownish object that looks like Fig. 1. a, b, c, or d, watch it attentively and see if in a few minutes the shape of the head will not change, or it may move or disappear with a jerky motion. At times Rotifers are seen sailing in the water or crawling curiously. These animals are so small and sometimes so hidden under the leaves that they are difficult to find, but once seen they will be readily recognized.

Fig. 1. a, b, c and d, represent Rotifer vulgaris as it is usually seen among the leaves. This species has a soft, transparent body, a head (Fig. 2. e.), two ciliated wreaths, f, two eyes, g, a mastax or apparatus for grinding its food, h, an alimentary canal, and a foot, k. The extremity of this foot is forked and secretes a gelatinous substance by which the animal is able to attach itself. The foot is so arranged that one part can be drawn inside the other like a ship's telescope. At Fig. 1. b, the animalcule is attached to the leaf by his foot, and his antennæ are extended in search of food. When food is found he expands the ciliated wreathes and sets them in motion. This makes a current in the water and draws the food within reach. It is then sucked into the mouth. This current can be seen and by it the Rotifier can often be discovered. These ciliated wreathes are two cup-like bodies surrounded by cilia or hairs, (Fig. 2. f). The slapping of these hairs one against the other gives the appearance of a rotary motion, and from this motion they receive their name. When not in use these wheels can be drawn into the body, giving the head the shape shown in Fig. 3. m. Some of the Rotifers can detach themselves and swim, using these ciliated wreathes as propellers. The Rotifer vulgaris has a peculiar way

of crawling. They attach themselves by the head, shorten and broaden the body and draw in the foot. Then fastening themselves by the foot again, they elongate the body to its full extent and repeat the process. The body of the Rotifer is so transparent that the action of the mastax and the motion of the food in the body can be seen with a high power instrument and with this instrument the movement of the water in the body can be seen.

These animals are said to produce three kinds of eggs, a male, a female, and a kind that can be dried up and remain for a long time, and then under favorable conditions they may hatch. It has been proven that these eggs sometimes float in the air. If the water in which the Rotifer lives, dries up very slowly, the animal rolls itself into a ball, covers itself with a gelatinous substance which hardens aud retains sufficient moisture to keep the animal alive for a long time. Under favorable conditions it becomes active again.

XXI.—Vinegar Eels.

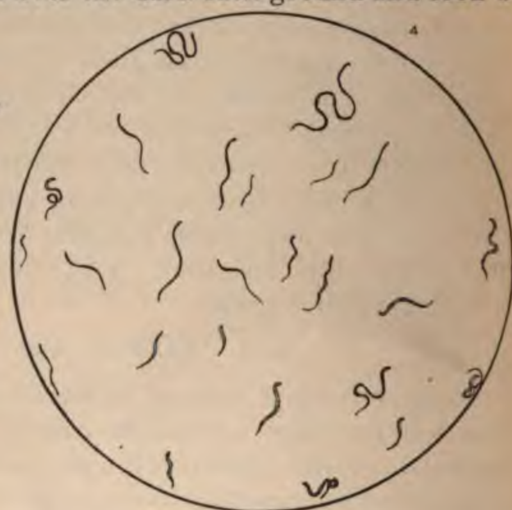
Some pure cider vinegar which has stood for a long time will probably contain the Anguillulæ aciti, or vinegar eels. With a little pipette, such as is used for dropping medicine, carefully take from the bottom of the vessel a little of the vinegar and place one drop in the center of the flat side of the stage, being sure to have the glass perfectly dry, or otherwise the liquid will spread over the glass and not be of sufficient depth. Place the two largest lenses together, arrange the mirror to show a bright field and focus carefully. Some small thread-like bodies will probably be seen wriggling about actively. These are the vinegar eels, Fig. 4. With the two lenses they appear to be from ¼ to ½ inch in length, but with the three together, a large one will appear to be from 1 in. to 1½ inches in length. Look at one that is

near the edge of the drop, where the liquid is shallow and its movements are not so active. Notice that it is shaped something like a snake, with one end rounded a little, Fig. 5. These eels do not have a true head or any organs of sense, but are like worms. After the vinegar has evaporated somewhat, a few may be seen curled up and quiet. Carefully add just a small drop of the vinegar and watch them. Soon they begin to move, at first very slowly, then they become active again.

Turn the stage over the dark back-ground and look at

5

4



the drop without the lenses. The eels can be seen moving about as little white specks. This shows how much more can be seen by careful observation after one has learned what to look for.

These animalcules are also found in sour paste. If the paste in which they are seen be allowed to dry up and then after a long interval a small piece is added to some fresh paste, in a day or two the whole mass will be swarming with these creatures.

Another species is found in wheat affected with "cockle." If a grain of this wheat, which looks like a black pepper

corn, be cut open it will be found to be filled with a white, cottony substance. Soak this for an hour in water and then place a little under the microscope, add a drop of water, place over it a cover-glass (which is a circle or square of very thin glass made for the purpose), and there will be seen a wriggling mass of eels. The anguillulæ are entirely harmless to man.

Some Easy Experiments.

By FRANK T. GREEN,
SAN FRANCISCO, CAL.

Many branches of study are anything but pleasing in the abstract. Microscopy is one of them. In order to appreciate the study in its truest beauty, one must study closely nature's infinitesimal details.

Berry Benson tells of a man, "lying on the grass peering at it and among it, studying it curiously and intently with a magnifying glass. His friend passed by and asked; 'what are you doing there?' Said the man, 'I am traveling in a foreign land.'"

Just so with the microscopic worker, whether he be a child from school or a teacher—versed in the study of the infinitely little. For it opens a new field, yes, "a foreign land" to the investigator, the teacher and the child.

One of the greatest drawbacks to any study or any occupation is an unfortunate introduction. If the student first hears of microscopy as the art of slicing tough and horny roots into sections of transparent thinness, and failing in this, then trying it over and over again to his sorrow, he naturally will bear a grudge against the science. Better by far have him reach out for something easier of attainment, and yet giving rare chances of learning the detail of little things from actual observations.

If anyone will take a shaving of wood thrown off

by a sharp plane, cut it into a neat little square, say one-quarter of an inch, wet it with turpentine, in order to drive out the air, also rendering it transparent, then immerse it in prepared balsam, putting it on a slide, and slipping on a cover-glass, he will have a most beautiful section showing the long cells with the lenticular markings or bordered pits, if it be from one of the pines or its relatives. He can see how nature employs the medullary rays, diverging from the pith to the bark, as the woof. with the warp or vertical woody tissue, in order to weave that network of ligneous cells combining flexibility with strength. A section of redwood shows the horizontal cells gorged with brilliant ruby-colored resin. A few years ago, I noticed on an apple box a narrow board showing successively the colors, white, cream, yellow, red and brown, all in a width of half an inch. I still have the shaving, mounted, and it is pretty, indeed, to observe how the resin cells increase in number and depth of color, thus giving this California cedar its deserved name of redwood.

The pappus from the dandelion is very easy to mount and is well worth the time. On a clean slide describe a circle a little smaller than your cover-glass, say seven-sixteenths of an inch in diameter, using a turn-table and employing a small camel's hair pencil wet with colorless balsam. In the central space, which is dry, put a seed or pappus of any small compositæ, cover it, pressing down the glass gently ; it will then adhere to the first ring. When dry, ring again on the outside edge with colorless balsam. You will have a delicately beautiful slide—and one to be proud of—mounted in air, as the microscopists say.

The Chinese shavings sold in the shops make an ideal longitudinal section all ready to mount. The epidermis of any leaf shows the stomata or breathing pores, if simply wet with alcohol, then turpentine, and lastly,

mounted. If you use the polarizer with it, you will find it equal to double staining as regards the distinguishing of different tissues.

Fuller's earth, tripoli and electro-silicon show scores of silicious forms beautifully symmetrical all classified as diatoms or other organisms by the scientists. Lupulin, lycopodium and starches all have a structure which the microscope reveals clearly.

Put a drop of pure comb honey on a slide some time, cover it, and when magnified you will see grains of pollen which have fallen from the broad and fuzzy backs of the indefatigable little workers, the bees. As an analytical point in the identification of honey, you can remember that the artificial honeys show no such companionship, for that honey is as far away from the pollen-laden flowers as it has been from that busy little community, the bee-hive.—*Pacific Druggist.*

Mounting in Canada Balsam.

By NO SIG.

Every one after having prepared his objects or sections, is desirous of preserving them in a permanent form in as neat a manner as possible and that with the least trouble. The following manner of proceeding will assist in obtaining good results.

Turn a circle on the back of the slide in ink with a pen, being careful that the circle is rather smaller than the thin glass it is intended to employ, so that the refraction of the balsam at the edges of the glass do not interfere with placing it true in the center; the best turn-table to employ is the concentric turn-table, made by Aylward, of Manchester, Eng. The slides must always return absolutely to the same center.

When the ink is dry, wipe the front of the slide well with a clean cloth, and press or drop two or three drops

of balsam or balsam dissolved in benzole in the center of the glass slide, take your object out of the turpentine it is soaked in, with a small pair of pliers, and place it in the balsam with the hollow curved side of the preparation down if it is not quite flat. Then turn it over on the other side to release any air bubbles that may be en closed underneath, then adjust it well in the center with a needle point, put a drop of balsam on the top, and place the slide on one side protected from the dust for 24 hours.

Clean a cover-glass the size you wish to use, see that the preparation is well centered. If it is not right it can be moved by the needle point, the balsam not being hard enough to prevent it, but if the preparation is very delicate, it will be necessary to warm the slide on the hot-table to soften the balsam before attempting to disturb it; when everything is right, place a drop of balsam on the top. This is to fill up any hollow that may form in the center of the balsam, which would hold the air when the cover is put on it. Place the cover gently in the middle of the slide, letting it sink down by its own weight at first, press gently with the needle, being carefulto have the cover properly in the center. If not quite centered, shift it with the needle point till it is quite true. The preparation will not move in the balsam for some time till the fresh balsam has penetrated through the dried balsam put on the day before. If you find that the object has moved out of the center then comes the difficulty of getting it back again without beginning the whole process over again. Have two needles by you, as one is sure to get messed with balsam which will get on the front of the cover-glass and bother you in centering the object. Notice to which edge of the cover-glass the object is nearest, and with the needle point draw the cover-glass by pressing on the top towards the edge of the slide. In this way the cover will slip over the

object without displacing it. Then push the cover back by the edge when it will take the preparation with it. In this way, by a little patience, the object can be shifted to any part of the slide. If you try to get it in the center by pushing the cover first from the edge, you will soon find that the object will work right out of the field. Having got everything right and true, put a light brass clip on to hold the cover in its place to dry. If you put too strong a spring on the preparation it may force the cover up when the spring is released. It is better to remove the surplus balsam with a knife, at once, while it is soft, wiping the balsam off of the knife with a piece of paper. Place the slide away for a few days to allow the balsam to harden, when you can clean off the slide with methylated spirit, or better with benzole. When the slide is nice and clean, put it on the turn-table and run a ring of gum water round the edge of the cover-glass. When dry, give it another coat. This is to prevent the white zinc or other cement being dissolved by the benzole and running in under the cover-glass. If pure balsam is used, there is much less risk of this occurring. A very neat finish is given with white zinc cement. It is easy to work and gives a good, hard, brilliant surface, on which can be put a ring of black or any other colored varnish. When you have finished, clean the brush well by means of benzole; wipe the brush on a piece of paper between the fingers first, when the brush can be cleaned with a very small quantity of benzole and very quickly.

The Serum Treatment of Diphtheria will be explained in The Popular Science Monthly for February, by Dr. Samuel T. Armstrong, Visiting Physician to the Hospital for Contagious Diseases, New York.

The article will be of much interest to bacteriologists.

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CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

The Microscope and Public Health.—In Maine, 1513 persons die every year of tuberculosis,—an entirely preventable disease.

In New York City, 3673 more infants died in 1882 than in 1883. The milk was examined in 1883 and not in 1882.

Meat may be contaminated with micro-organisms either by exposure to flies or to street dust.

Meat from tuberculous animals is sold to our own people. That exported to Germany must be proven free from this disease.

Ninety per cent of the typhoid cases are due to drinking infected water. Boiling the water would render it harmless.

Last year, 455 persons died in Allegheny and Pittsburg from typhoid fever. This is nearly ten times the death rate of London, where the water is filtered through sand and other hygienic matters are looked after.

The microscope gives us adequate means for discovering how to remedy such evils as the above. It should be regarded as a crime for any physician to try to practice medicine until he is provided with this iustrument and knows how to use it. Public officials should be actively engaged in seeking the public

welfare, but the public office in America is now "a private snap" and the incumbents think how to make money out of it. Their actions mostly correspond with Vanderbilt's epigram,—"The public be d—d," and it often is—with disease and death.

QUESTIONS ANSWERED.

NOTE.—*Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of all grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.*

218. *Please inform me how to measure the value, or magnifying power of objectives and eye pieces?—Dalton.*

Col. J. J. Woodward's method is not very precise but simple and sufficient for ordinary purposes. Use an eye-piece fitted with a micrometer, but with the field lens removed. Place a stage micrometer beneath the objective. When in focus, the two micrometers must be at least 10 inches apart. Then the true focus of the objective will equal the magnification multiplied by the distance and divided by the square of the magnification plus one. Suppose when adjusted as above, that one division of the 1-100 inch on the stage micrometer, at 10 inches distance, appears to cover 18 divisions of 1-100 -inch, of the eye-piece micrometer then 18 multiplied by 10 and divided by the square of 18 plus 1; equals 180 divided by 361; equals .5 or one-half inch, the focus of the objective. If one uses a positive eye-piece, in which the micrometer lies below the field lens, the latter need not be removed. See A. M. M. J. 1885, page 141, for more accurate methods for finding the optical center and rating of an objective.

The following approximate method will enable one to determine the magnifying power of an ocular. Use an objective of known focus, i. e. power, and a tube length that will place the optical centers of the eye-piece and objective ten inches apart, as nearly as possible. Place a stage micrometer in position, turn the microscope body to the horizontal and place the instrument on a box or on blocks to raise the center of the eye-lens just ten inches above the table. Slip on a camera lucida and compare the image of the micrometer ruling with an inch

rule. This will give the magnification of the combination. Then the combined power divided by the known power of the objective will give the power of the eye-piece. Prof. J. Edwards Smith, in his work, "How to see with the Microscope," gives the true magnifying power of single convex lens at ten inches, as follows :

One inch equals 8 diameters; ¼ inch equals 38 diameters; ⅙ inch equals 58 diameters; 1-10 inch equals 98 diameters. An objective properly rated, of 1 inch focus, should magnify 8 diameters, and with a one-inch eye-piece at ten inches, should magnify 64 diameters.

219. *How may the owner of a small aquarium like that of Tempere, learn to identify the forms?—Dalton.*

Stokes' Microscopy for Beginners—price $1.50—will give the needed information. It tells all about life in our ponds and ditches.

220. Where can I obtain the latest edition of Griffith and Henfrey's Micrographic Dictionary?—I. H. H.

The Micrographic Dictionary is published by John Van Voorst, Paternoster Row, London. It is listed by Bausch and Lomb Opt. Co., Rochester, N. Y., at $20.00 net.

PRACTICAL SUGGESTIONS.

By L. A. WILLSON,

CLEVELAND, OHIO.

Magnification.—Mere amplification of an object is useless for nearly all purposes. Definition and disclosure of detail are of scientific value. Never use upon an object a higher power than is necessary to show it well.

Killing and Preserving Delicate Organisms.—Perchloride of iron is one of the best agents for this purpose. The organisms referred to are such as Rotifer vulgaris and other ciliata. With this agent the animals are fixed very perfectly in their expanded condition nicely exhibiting their cilia. For ordinary use a solution in alcohol containing about two per cent of the compound should be used.

The animals may be placed on a slide without cover and the

solution dropped over them. When it is desired to obtain a large number of the organisms, they may be killed in a vessel and then a stronger solution must be used. In the vessel, the animals will fall to the bottom; the water should be drawn off above them. Then add seventy per cent alcohol and replace this with alcohol slightly acidified with hydrochloric acid. This latter solution should be run over the animals fixed upon a slide. The effect of the latter solution is to remove all trace of the iron salt. This should be immediately drawn off and pure alcohol added. The animals can then be mounted in glycerine.

Mounting Hydra.—Hydra viridis is nearly always to be found on the under surface of the leaves of Lemna. It is also found adhering to other plants. For an acceptable mount it should be prepared so as to exhibit its expanded tentacles. The following is a method by which this may be accomplished. Have a slide with a well dried cell of sufficient depth; drop the hydra on the end of a plain glass slip. Hold the slip near the top of the chimney of the student lamp. You can see then if its tentacles are expanded. If they are, quickly hold the slip with the hydra over the chimney end about an inch above it. Hold it there from three to five seconds; then quickly place the slip upon a cool, heat-conducting surface. When cold transfer the animals to the prepared cell and mount in glycerine. All kinds of hydra and many other of the larger zoophytes may be fixed and mounted in this manner.

How to Examine Coal.—Coal is of vegetable origin. To examine its structure it is necessary to have very thin sections. To obtain such sections, macerate the coal for about a week in a solution of carbonate of potassium when thin slices may be cut with a razor or a microtome. These sections should be gently heated in nitric acid, and when they turn yellow, should be washed in cold water and mounted in glycerine. Spirit or balsam will render the sections opaque.

SCIENCE-GOSSIP.

Drinking Cups and Diphtheria.—Dr. Chas. H. Stowell, formerly Editor of *The Microscope* says of Washington Schools;

A few days ago I was greatly surprised to learn that the old drinking cup was still in active use in our schools. This is such a total disregard of all ordinary precautions for the prevention of disease that it hardly seems possible. Yet in one of our largest schools there are just six of these tin cups used by the whole school for drinking purposes. Now it is a well established fact that diphtheria is caused by a specific germ. It is also well established that this germ may reside in the throat some time before the symptoms of diphtheria appear. Recent investigations on this subject in New York City showed that a small per cent of the children examined had this cause of diphtheria existing in the throat, and yet did not exhibit any of the symptoms of diphtheria at the time of the examination. Some of the secretions from the mouths of such children, if carried to the throats of others, would quite likely cause this disease. When diphtheria is present in this city it would not be at all surprising to find that in a large school there would be a small per cent of children who could communicate this disease to others.

And yet, the school trustees allow a tin cup to be passed from one mouth to another! The use of a common drinking cup by a number of school children should be relegated to the ignorant methods of the dark ages. Not a cup should be provided by the school authorities. Each child should bring his own cup. You cannot do anything better than to forbid this promiscuous use of the drinking cup.

CORRESPONDENCE.

How to find Diatomaceous Earth.—Mr. W. A. Terry of Bristol, Conn., sends us the following:

It is asked how we know when we have found Diatomaceous Earth? It is of course impossible to be absolutely certain until the find has been examined under the microscope, still a collector of experience and good judgment will make few mistakes. The fresh water deposits are almost invariably covered by a layer of muck or peat. A light-colored stratum below muck will be either *lime*, *clay*, or *diatoms*, if it is not *sand*. Sometimes *all* mixed. If the material dries of a light gray or ash color and is also light in weight, it is almost certain to be rich in diatoms.

If the deposit is heavy, it is mostly clay or exceedingly fine silicious dust; it is always well to examine all such deposits under the microscope, and, if not rich they may contain rare varieties.

The marine deposits underlying the peat of all salt marshes of the Atlantic coast always contain diatoms; in some localities these are comparatively rich, and frequently contain deep water forms. The diatoms are not equally distributed through these deposits, but are apt to lie in thin streaks or in pockets; and strata holding shallow water forms and those containing deep water kinds are sometimes in close proximity. Where ditches have been dug through these marshes for drainage, material containing very interesting varieties is frequently thrown up. Shallow water kinds usually predominate near the surface, and below are streaks of deep water forms alternating with those of brackish water down to a depth of over twenty feet in many places.

On the New England coast, it is not very unusual to find these deposits to be from thirty to fifty feet in thickness. Where the deposits were laid down by strong tidal currents, few diatoms will be found. They deposit in eddies and basins after the coarse sand has been left behind.

These hints will be sufficient to guide the efforts of persevering and intelligent investigators in search of Diatomaceous Earth; but they must understand that tiresome and disagreeable labor is inevitable if they would win success. At some future time I will give more detailed instructions.

TO THOSE WHO HAVE REMITTED FOR 1895.

We feel especially and unusually thankful to those who have sent in their checks during the past five weeks.

Like others, we are struggling with the "hard times" and your promptness helps materially. We cannot write personally to thank each one, but we take this means of telling you how sincerely we appreciate your thoughtfulness. In spite of the times, which we believe will change before mid-summer, we shall be able to increase the number of our illustrations during the year.

THE MICROSCOPE.

Contents for February, 1895.

THE MICROSCOPICAL JOURNAL.

Contents for January, 1895.

THE MICROSCOPE.

MARCH, 1895.

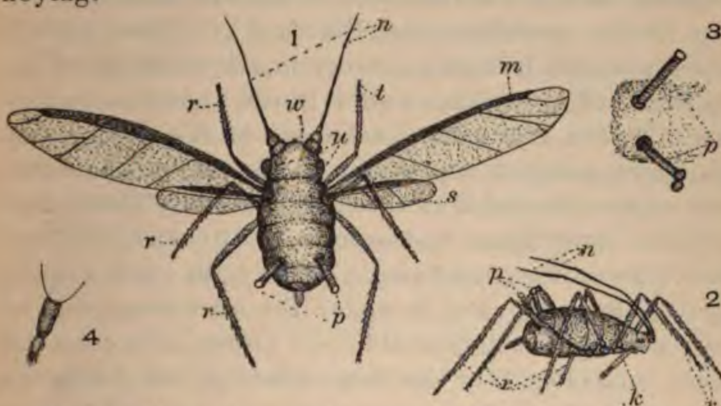
NUMBER 27. NEW SERIES.

Objects Seen Under The Microscope.

BY CHRYSANTHEMUM.

XXII.—APHIDES.

Almost everyone who cultivates flowers has seen the green Aphides or plant-lice, which are so troublesome on the roses, sweet peas, verbena and other house and garden plants. Perhaps a study of them and of their habits will make them more interesting if not less annoying.



With a dissecting needle or wooden tooth-pick transfer one of these insects to the center of a glass slide and with a pipette slowly and carefully drop a little alcohol on it. After a few minntes remove the alcohol that remains by touching the drop with a piece of blotting paper, which will absorb the liquid and if sufficient care has been taken will leave the Aphis in a standing position.

Observe that the head (Fig. I, *w*) is not separated from the body as in the fly, but that head, thorax and abdomen seem to be all in one piece; that it has two eyes, (Fig. I, *u*) one on either side of the head; that these eyes are compound; that the antennæ (Fig. I, *n*) which have seven joints are long and slender and when carried over the back reach beyond the body (Fig. 2, *n*); that the legs (Fig. 1, *r*) are six in number and they also are long and slender in comparison with the size of the body; that the tarsi (Fig. 1, *t*) have only two joints and that the legs are covered with delicate hairs. Viewed as an opaque object the eyes look like two deep rubies set on the sides of a somewhat oval emerald, the legs and antennæ like sparkling amber and in case of one of the winged Aphides; the wings show fine iridescent colors. Altogether it is a beautiful object.

On the back, toward the end of the abdomen, are two very slender protuberances (Fig. 1, p). These are the tubes from which exudes a sweet liquid which drops on the leaves of the plants, and is there known as honey-dew. To see this honey, take one of the glass slides containing a slight depression in the center, and carefully remove an Aphis to the center of this. Then place over it a cover glass and secure it with two or three small pieces of gummed paper, placing the cover so as to admit a little air. Put it under the microscope and in little while you will probably see either a drop on the honey tube (Fig. 3) or the drop where it has fallen on the glass. The little red ant is very fond of this honey, and is found on the plants infested with these insects. They not only eat the honey which has fallen on the leaves, but take it from the honey tubes. The ants make the same use of the Aphides as we do of cows. Some species of the Aphides live on the roots of plants.

Rusticus, in his letters, says: "Another odd station for the Aphides is on the roots of plants. The other day

I pulled up a large thistle that grew on an ant hill and found a whole colony of Aphides. I shook down some dozen of them among the ants. No sooner were the ants aware of the presence of the Aphides than they began to fondle them with their legs, sometimes positively taking them around the neck, to tap them on the back with their antennæ and to lick them with their tongues. The ants then took hold of them with their jaws and lifted them from the ground and carried them with the greatest care, one by one, into the recesses of the nest. I have often watched an ant go from one Aphis to another, stand behind each, and gently squeeze the body with its forelegs. Perhaps one Aphis in ten would give out a drop of honey, which the ant immediately swallows. The ants take much more care of the Aphides than the Aphides do of themselves. It is very pretty to see the licking and washing and cleaning and caressing which the ant constantly bestows upon them."

The Aphis lives on the juices of the plants which it inhabits. It is provided with a tubular proboscis (Fig. 4) for sucking these juices, and when this is not in use it is carried under the breast (Fig. 2, k), where it is seen with difficulty unless the insect be held in the stage forceps. The Aphides multiply very rapidly, the wingless insect (Fig. 2) producing young like herself, only smaller, and as many as fourteen in a day. The life of an insect is from two to three weeks, and it is said that a single Aphis and her descendants can produce as many as 23,740,000 in a single summer. Towards the end of summer the true winged males (Fig. 1) and females appear and lay eggs which hatch the following spring, thus perpetuating the species.

These insects are often destroyed by fumigation with tobacco, but nothing is more effectual than their natural enemies, the lady-birds. Not only do the adults feed on them, but the mother insect lays her eggs in packets

among the Aphides, and as soon as the young larvæ are able to move about they begin to feed upon them, and in a few days not an Aphis will be found on the plant. Some of the Ichneumon flies and other insects destroy the Aphides by laying their eggs in its body. The larvæ feed upon upon the insect and escape, leaving the skin of the Aphides brown and dry. These skins are often found, sometimes with a fungus growth upon them. The larvæ of the Ephedrus plagiator escape by a little hole in the side of the body, to which a circular door is attached by a piece of uncut skin. The larvæ of another insect escape by pushing off the three last segments of the abdomen.

A Model to Follow.

BY RENE SAMSON,
WASHINGTON, D. C.

Last October, I spent an evening in Paris with Mr. George Clifford the author of several articles in the micoscopical periodicals of Washington signed "No Sig" when he kindly showed me under the microscope the most interesting slides of his collection and explained to me his practical methods in microscopy which have been or will be described in these periodicals.

Mr. Clifford can certainly be called"a model to follow" for a beginner or amateur microscopist. I would have been happy to have had our readers admire this worker in science, enjoy an evening with his instruments and see with what methods he proceeds in everything.

The principal rules he follows are: The working table of a microscopist must always be cleared off. As soon as he is through with an instrument, a bottle or a book he must put it back in its own place. After using a brush it must be cleaned immediately, before puting it aside. Always wipe the neck of a

bottle after pouring a liquid. All his instruments are kept in a closet, out of the dust and in the most perfect order; if he needs one of them he finds it at hand, cleaned and ready to use.

All his slides, classified and catalogued, are kept in a splendid cabinet. Visitors are surprised when they learn that in that fine piece of furniture thousands of slides are contained, among which many have a value from ten to twenty dollars apiece.

Working as he does there is no need of a laboratory; a corner of the table of the dining-room is sufficient.

Mr. Clifford receives the best microscopical papers published in French, English and German. One department of his library is especially reserved for scientific works. Many of these books are the latest publications, many old and rare editions are to be found there also.

The great desire of all the young beginners, readers of this periodical, ought to be to own one day as he does a fine set of instruments, a beautiful and numerous collection of slides and a valuable library.

Our friend has been in Paris over twenty years being originally from England. He is a very warm personal friend of the Editor of this periodical who has visited him several times. Of course, he has complete files of the American microscopical periodicals.

The Value of the Microscope.—The value of a microscope to a druggist is shown by the following incident: A lady had procured from the stores pepsin much cheaper than she had been paying her family chemist, and complained of the surcharge. He obtained a specimen of the medicine, and was soon able to demonstrate to the customer by the microscope that she had paid too much for her specimen, for it was nearly all starch. She does not go to the stores for pepsin now.—*Chemist and Druggist.*

The History of the Royal Microscopical Society.

By A. D. MICHAEL,
LONDON, ENGLAND,

At the annual meeting of the above named society the president gave an address in which he said that if any of his hearers would leave that West-end abode of science and journey eastward to Tower Hill,and thenceby Sparow Corner along Royal Mint Street, he would find himself in Cable Street, St. George's in the East, not a very quiet or a very clean locality: turning down Shorter Street he would emerge opposite a space of green, where once stood the Danish church with its Royal closet reserved for the use of the King of Denmark when visiting this country. The space is surrounded by houses which have seen better days, and amongst them, between a pickle-factory and a brewery, stands a rather dilapidated erection which is 50, Wellclose Square; where, in 1839, lived Edwin J. Quekett, Professor of Botany at the London Hospital; and there, on September 3 of that year, seventeen gentlemen assembled "to take into consideration the proposition of forming a society for the promotion of microscopical investigation, and for the introduction and improvement of the microscope as a scientific instrument." Among the seventeen, were N. B. Ward—the inventor of the Wardian case, which is not only an ornament to town houses, but was the means of introducing the tea-plant into Assam and the cinchonas into India—who became treasurer of the Society; Bowerbank Lister, who has been called the creator of the modern microscope; Dr. Farre; Dr. George Jackson; the Rev. J. B. Reade; and the enterprising and scientific nurseryman, George Loddiges. Most of these subsequently became presidents of the Society. A public meeting was held on December 20, 1839, at the rooms of the Horticultural Society, then at 21, Regent Street, when the "Microscopical Society of London" was formally started.

Professor Richard Owen (not Sir Richard at that time) took the chair, and became the first President; and shortly after the famous John Quekett became secretary, an office which he held almost to his death.

At this moment Schleiden in Germany was commenting upon the paucity of British microscopical research, and attributing it to the want of efficient instruments, not knowing that a society was then forming which was to raise British microscopes to probably the first position in the world. The President then traced the history of the Society through the presidencies of Dr. Lindley, the botanist, Professor Thomas Bell, the zoologist, Dr. Bowerbank, Dr. George Busk, Dr. Carpenter, Dr. Lankester, Professor W. Kitchen Parker, all deceased; and of others equally famous who are still living; and showed how, under its influence and by its assistance, the vast improvements in the microscope, and the enormous extension of its use, had gradually arisen. He also described its connection with the origin of the "Quarterly Journal of Microscopical Science," the "Monthly Microscopical Journal," and other publications, besides its own present widely circulated journal with its exhaustive summary of microscopical and biological work. He related how on John Quekett's death certain members of the Society subscribed to purchase for the Society's collection a curious microscope which Quekett possessed, and which had been made by the celebrated Benjamin Martin about 1770, probably for George III., and how they extended their subscription so as to provide a medal to be called "the Quekett medal," to be given from time to time to eminent microscopists; and how, difficulties having arisen, it happened that the only Quekett medal ever awarded was given to Sir John Lubbock.

Finally the President considered the future of the microscope and the prospects of further improvements. He said that many people were of opinion that the ins-

trument is now perfect, and that consequently the most important *raison d'etre* of the Society was over; he by no means agreed in that view; he believed that there was as much scope for progress in the future as there had been in the past. It was not by any means the first time that this idea had been put forward. In 1829, Dr. Goring, then a great authority on the subject, wrote in one of his published works, "Microscopes are now placed completely on a level with telescopes, and like them, must remain stationary in their construction." In 1830, less than a year after, appeared Lister's epoch-making paper, "On the Improvement of Achromatic compound Microscopes," and we have been improving ever since.

Pharmaceutical Journal, London.

A New Peritrichan Infusorian.

BY T. B. REDDING,

NEW CASTLE, IND.

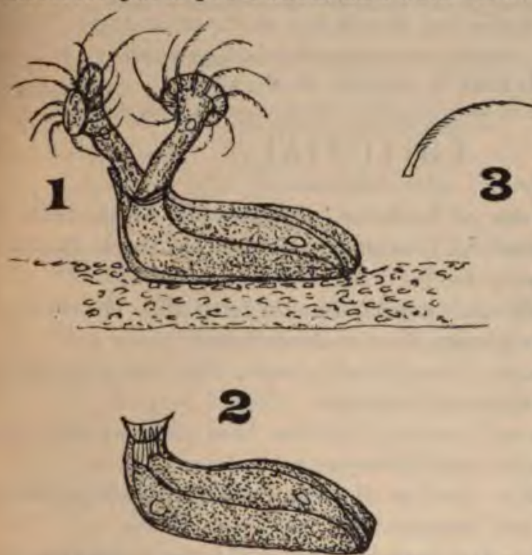
On the 17th of January, 1895, I found, on a filament of Vaucheria sessilis growing in a jar, in my green-house, where it had been at least eighteen months past, an Infusorian entirely new to me, though I have studied the Infusorians for more than ten years past and made hundreds of drawings of them.

I refer it to the order Peritricha Stein; sub-order, Sedentaria; sub-family, Vaginicolinæ; Genus and Species, doubtful.

The lorica is sessile, of a pale brownish color and membranous. Length of lorica 1-216; width 1-700; neck of animal, when fully extended, as long as body, or lorica, or nearly so; diameter 1-1,600; length of cilia various, from 1-700 to 1-900 inch; with two much longer. Opening of lorica 1-1050 inch wide.

There were two animals in same lorica, but whether united or not I could not determine, but I think not.

Cilia inserted under and upon the lower border of oral disk, as shown in fig. 1, and fringed on curved side with very fine serrations, as shown in fig. 3. When at rest cilia lie flat, curved upon the margin of the oral disk. The left hand disk, in fig. 1, appears double, the upper disk having two very long cilia, one on each side. Food was ejected through the upper and received into the lower opening. Figure 1 shows the infusorian with anterior parts protruded, and with cilia expanded.



Just below the oral disks is a contractile vessicle in each of the animals, pulsating once in 30 to 45 seconds. Also a vessicle in the body, as shown. On the slightest disturbance the animals almost instantaneously withdrew into the lorica. When about to protrude from the shell they appeared as in fig. 2, with cilia in shape of a pointed brush. No valve could be discovered.

Particles of food were easily seen passing down and up through the extended necks near center.

On examination the next evening the animals were dead, but the lorica was in good shape. They were kept over in a moist chamber under cover on slide.

I find several other species and genera of the Peritricha in this vicinity.

Mr. Redding would perhaps assist our readers about identifying forms they may find.—*Editor.*

THE MICROSCOPE.

New Series, 1893.

For Naturalists, Physicians, and Druggists, and Designed to Popularize Microscopy.

Published monthly. Price $1.00 per annum. Subscriptions should end with the year. The old series, consisting of 12 volumes (1881–1892), ended with December, 1892. Sets of the old series cannot be furnished. All correspondence, exchanges, and books for notice should be addressed to the Microscopical Publishing Co., Washington, D. C., U. S. A.

CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

Economic Uses of Lichens. 1. Iceland Moss, Cetraria islandica, is boiled and eaten with milk by the Icelanders. Often it is their only food.

2. Reindeer Moss, Cladina is powdered and mixed with flour. It is an important food of the reindeer.

3. Tripe de roche, Gyrophorei, is eaten after being boiled by the Canadian hunters and Indians.

4. Manna lichen, Lecanora, has often been eaten by men and and cattle in Algiers and Tartary.

5. An alcoholic spirit is distilled from Cladina rangiferina in Scandanavia and Russia.

6. Sticta pulmonaria is used in place of hops in brewing.

7. The dyes, archil, cudbear and litmus are derived from Roccella, purple dye, Lecanora, red dye, Ramalina, Parmelia, Umbilicaria, etc.

8. A substitute for gum-arabic is obtained from Ramalina fraxinea, Evernia prunastri, and Parmelia physodes.

9. Perfumery has been obtained from Usnea, Ramalina, Evernia and Cladina.

10. Jaundice has been treated with Platrysma juniperinum.

11. Pertusaria amara is a febrifuge.

12. No lichen is poisonous.

Those interested in collecting Lichens will find a key to the genera in the American Monthly Microscopical Journal for

March, kindly prepared by our assistant, L. W. Willson, who is in charge of the Department of Practical Suggestions.

Where to Hunt Lichens. The following data are compiled chiefly from the Encyclopaedia Britannica, 9th Ed.

Lichens are never found on cultivated ground nor in atmosphere impregnated with smoke. They demand a quiet and exposed situation.

1. The rugged bark of old trees. (Ramalina, Parmelia, Stictei.)
2. The smooth bark of young trees and shrubs. (Graphideus, Lecidea.)
3. Trees by roadsides (Physcia) or in large forests. (Usnea, Alectoria.)
4. Decayed wood of trees and old pales. (Calicieus, Lecidea, Xylographa.)
5. Calcareous and cretaceous rocks. (Lecanora, Lecidea, Verrucaria.)
6. The mortar of walls. (Lecanora, Lecidea, Verrucaria.)
7. On calcareous, peaty, and argillaceous soils, and on hardened mud. (Cladonia, Lecidea, Lecanora, Collema, Peltidea.)
8. The sands of sea-shore and the granitic detritus of lofty mountains.
9. On decayed mosses and moss-like plants. (Leptogium. Gomphillus.)
10. Upon perennial leaves of certain trees and shrubs (Lecidea, Bouteillei, Strigula.)
11. On tombstones, old leather, iron and glass, on the bleached bones of reindeer and whales, on the dried excrements of sheep.
12. Parasitical upon other lichens. (Lecidea, Pyrenocarpei.)

QUESTIONS ANSWERED.

NOTE.—*Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of all grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.*

221. *Is there any good work containing the classification of Bacteria and descriptions of methods of cultivating them?*

If you want the best, pay $10 for Sternberg's Bacteriology. If only the rudiments, we can get you Ball's Essentials of Bacteriology for about $1.25 postpaid, or for $2.25 we can order Reeves' Medical Microscopy which contains colored illustrations of Bacteria with descriptions and will besides give you lots of information about urinalysis, the blood, etc.—C. W. S.

222. *I wish to use mounted specimens and project the image through a microscope upon a screen.—Can I use a lamp or gas light for illumination?—W. F. Proschwitzky.*

You will require an oxy-hydrogen lime light or a small electrical arc light. The pencil of light must be small enough to pass through the small lenses of the objective and bright enough to bear the subsequent spreading out upon the screen.

PRACTICAL SUGGESTIONS.

By L. A. WILLSON,

CLEVELAND, OHIO.

The Mounting of Sponge Spicules.—First place a drop of balsam on the center of the slide. Then sprinkle some spicules over the drop and cover with a thin glass. Then heat and boil until all bubbles disappear. Set away to cool and a good slide will be the result. The large spicules may be arranged and mounted as opaque objects and will thus make very beautiful slides.

Cleaning and Dismounting Slides and Covers.—Heat the slide with the cover over a lamp until the cover moves. Then remove the cover; soak cover and glass slip in turpentine. A drop on each will be sufficient. Then wash in a drop of alcohol and wipe with a smooth linen cloth. If it be desired to have the slides chemically clean, soak them in strong sulphuric acid containing some crystals of potassic bichromate, allowing the slides to remain several days in the liquid.

To Preserve Algæ.—Camphorated water and distilled water, each 50 grammes; glacial acetic acid, 5 gr.; crystallized nitrate of copper, each 2 grammes; dissolve and filter. Specimens thus prepared will retain their living appearance.

To Fix Cilia of Infusoria.—In a drop of water containing

Paramecia or other infusoria upon a slide, drop a minute quantity of tannic acid. If the solution is too weak, the cilia are not immediately arrested, but if the solution is of the proper strength they will stand out straight. After this treatment the infusoria appear beautifully with a paraboloid. The solution of tannin is made by dissolving one part of tannin acid in, four parts of glycerine.

Collecting Specimens.—During March, April and May many beautiful specimens may be collected from ponds. Scrape off any gelatinous matter. For small animals use a small hand net, made of common cloth and troll this along the bottom. Such a net must not be more than three inches in diameter.

SCIENCE-GOSSIP.

List of Exhibits at the Eighth Annual Exhibition, Department of Microscopy of the Brooklyn Institute of Arts and Sciences, Art Association Hall, 174 Montague St., Brooklyn, Monday, January 14, 1895.

Bausch & Lomb.—Micro-Photographs. Descent from the Cross, and Portrait of Dr. Carpenter, F. R. M. S. Arranged diatoms. Head of louse, *Pediculus capitis*. Sea sand, Bermudas. Trachaea-potato bug, *Doryphora decemlineata*.

W. Bowdoin.—Vinegar eels.

Mrs. W. G. Bowdoin.—British diamond beetle, *Phyl. pomona.*

Frederick Kato.—Zinc oxide, an accidental crystallization.

Prof. W. C. Peckham.—Lingual ribbon of poludina.

C. P. Abbey.—Bouquet of butterfly scales, composed of 135 pieces.

Geo. W. Muller.—Polycystina.

Horace W. Calef.—Hairs of sea mouse, *Aphrodite aculeata*. These hairs form tufts of bristles which encircle this marine, spindle-shaped worm, and serve as weapons of defence.

Henry F. Crosby.—Foraminifera, Gulf of Mexico.

A. H. Ehrman.—Elytron (wing case) of diamond beetle, *Entimus regalis*. Pollen of corn cockle, showing anther beards, polarized.

James Walker.—Six rock sections from the drift of Brooklyn, shown with automatic revolving stage and polarized light. Cacoxenite on limonite, from Lancaster Co,, Pa., a hydrous basic phosphate of iron.

Louis W. Froelick—Spines of echinus.

M. H. Wilckens.—Sections of cork.

Dr. Heber N. Hoople.—Ovary of canna, cross section.

Frank Healy.—Crystals of salicin, shown with polarized light.

Dr. J. W. Metcalf.—Citric acid, shown with polarized light.

Chas. E. W. Harvey.—Tingis hyalina, a small insect, with thin wing covers filled with gauze-like meshes.

James Wood, M. D.—Trichina spiralis in muscular fibers of pork.

Dr. N. B. Sizer.—Tongue of a cat, showing gustative papillae.

D. A. Nash.—Transverse section of pine needle. Double stained.

Wm. Finney.—Rhinoceros horn.

Chas. M. Skinner.—Adamite, from Laurium, Greece.

Dr. A. J. Watts.—No. 1 gold crystals. No. 2 gold crystals.

John Lamont.—Section of fibrolite, from New York city, shown by polarized light.

H. S Woodman.—Eye of beetle, showing the revolution of the second hand of a clock through all the eye-facets which are in focus.

Dr. S. E. Stiles.—Section of jaw and lip of kitten one day old, showing tooth germ, glands, hair bulbs and hairs.

G. E. Ashby.—Cheese mites. Stilton. Fresh water shrimp. Polarized.

Rev. J. L. Zabriskie.—Soldier of one of our common ants, *Pheidole Pennsylvanica Rog.*, showing strong mandibles and enormous head. Collected at Fisher's Island, N. Y., August, 1891.

George M. Hopkins.—Incinerated leaf of deutzia, showing the star-like silicious hairs unchanged.

A. A. Hopkins.—Crystals obtained from black writing ink.

Prof. Wallace Goold Levison.—Natrolite, Snake Hill, N. J.

John W. Freckleton.—Section of chalcedony, by polarized light.

Dr. H. M. Smith.—Stem of rosa canina.

H. B. Baldwin.—Blood spectra. The upper spectrum is that of Oxy-Haemoglobin in normal blood. The lower spectrum is of a Reduced Haematin in blood, chemically treated, and shows the two dark lines a little further to the right.

J. A. Grenzig.—Sections of wood, shown by old microscope made by Jones & Son about the latter part of the Eighteenth century, with accessories, etc. The slides are made of ivory and the sections mounted between plates of mica.

Geo. A. Fiske.—Skin of skate fish.

John H. Royael.—Native copper, from Butte, Montana.

John J. Schoonhaven, A. M.—Foraminifera, from Cuxhaven.

Franklin W. Hooper.—Section of stilbite, from Upper Montclair, N. J. Polarized.

E. B. Meyrowitz.—Stem of pumpkin. Flea.

A. D. Balen.—Pond life.

J McCallum.-Blackberry. Tranverse section of stem of young plant.

F. B. Briggs.—Tranverse and longitudinal section of banana stalk. Polarized light.

Wm. Urban, Jr.—Section of elder tree. Section of quartz, *Pseudomorth*, after Pectolite, from Paterson, N. J.

Henry W. Schimpf.—The worm of the jumping bean, *Carpocapra solitans.*

Brooklyn College of Pharmacy.—Clove (longitudinal section). Oil

glands can be seen along the edge. Snake root (cross section of stem.) Quinidine, an alkaloid obtained from Cinchona. Cinchona, Peruvian bark. Crystals of chlorate of potassium. Crystals of sulphate of morphine. Mandrake root, *Podophyllum peltatum*, cross section. Water lily, transverse section. Fennel, triplet mericarps. Licorice wood, *Glycyrrhiza glabra*, (cross section). Ipecac root (cross section). Lycopodium adulterated with Pine Pollen. Slippery elm bark. Crystals of benzoic acid. Thorn apple, *Datura stramonium* (cross section).

Dr. Jos. H. Hunt.—Thin plates of quartz, shown with polarized light. These plates are natural groups of quartz crystals which are distorted into flat plates by being deposited between the layers of mica.

Sereno N. Ayres.—Three micro-photographs.

G. S. Woolman.—Insect scales, arranged in a bouquet of flowers.

Queen & Co.—Tongue of blow fly. Native wire gold, North Carolina. Crystals of copper.

E. C. Chapman.—Foraminifera opaque.

P. D. Rollhaus.—Seeds of the *Grandiflora imperialis*. [in motion.

F. L. Lathrop.—Aurichalcite, from Colorado, showing a deep cavity

William Krafft.—Sting of honey bee. Section of a lung of a coal miner. Blood from a frog. Proboscis of a butterfly.

H. Endemann, M. D.—A micro-spectroscope.

Officers of the department: Horace W. Calef, President. H. S. Woodman, Vice-President. C. P. Abbey, Treasurer, A. H. Ehrman, Secretary. James Walker, Curator.

Dr. Cutter's Method.—If tuberculosis in its earliest stages can be detected by looking at the blood with a microscope, as Dr. Cutter claims, then our scientists will have another test for tuberculosis which can be used either separately or together with the present tuberculin test. Dr. Cutter's method would be free from some of the objections to the tuberculin test; for only a very small quantity of the blood is needed and nothing is put into the animal's system, so that nobody could claim that the disease is hastened or favored by the test itself. The microscope test, moreover could be made quickly without the labor and delay of taking temperatures and watching results. It is also claimed that the disease can be detected in any stage from first to the latest, and that the extent of its ravages can be decided from the blood, so that mild cases need not be slaughtered as now but might, instead, be quarantined for possible complete recovery. Certainly the claims of this test and position of its advocate warrant investigation. As for Dr. Cutter's general theory, on the causes and cure of the disease, the evidence does not appear at all sufficient. It seems hardly to have been proved that the

substance found in the tuberculous blood is identical with the yeast germ, nor is it clear that the substance, although an accompaniment of tuberculous blood, is really a cause of the disease. As to the effect of ensilage, it is well known that tuberculosis has existed where silos were unkown. However, the theory is enough like the investigations of certain French scientists to be of considerable interest. Under the name of mycodermin, a substance derived from the culture of the yeast plant, has been advocated by eminent scientists of Paris as a cure for tuberculosis and remarkable success has been claimed. It is possible that with the American and French investigation combined we may yet be given a new and better theory,test and cure of this difficult disease. The fact of immediate concern, however, is the allegded new test which lays claim to certain merits not posessed by the test now in use.

RECENT PUBLICATIONS.

Sidney Forrester. By Clement Wilkes. New York. Jan. 1895. No. 1 of Castleton Series. 12° 351 pp. 50 cents.

This is a clean, interesting story of a boy who under the control of a rich, fussy and stingy old grandmother, grew up without religious or distinctly elevating influences but who developed much sense and goodness of character. How he came to be a noble young man in the midst of untoward circumstances is well portrayed, but h at were the causes of his virtues do not appear to the casual reader.

The purpose of the book seems to have been to afford the means of whiling away an evening (as we have done) in pleasant relaxation. There are no startling situations, no very improbable incidents, very few love episodes, no plainly moral teachings, no immoral nor questionable recitals, no allusions to religion of any kind direct or indirect.

It is a book for boys of average make-up, not those who crave blood-thirsty recitals, nor who read Sunday School books,but for boys, just boys. Incidentally, it is for all of us who like boys; not bad boys, not boys too good to live, but boys, frank, noble, generous boys, modest boys that are not too modest' peaceable boys, who nevertheless will fight when honor so demands,—in short boys of sense.

THE MICROSCOPE.

APRIL, 1895.

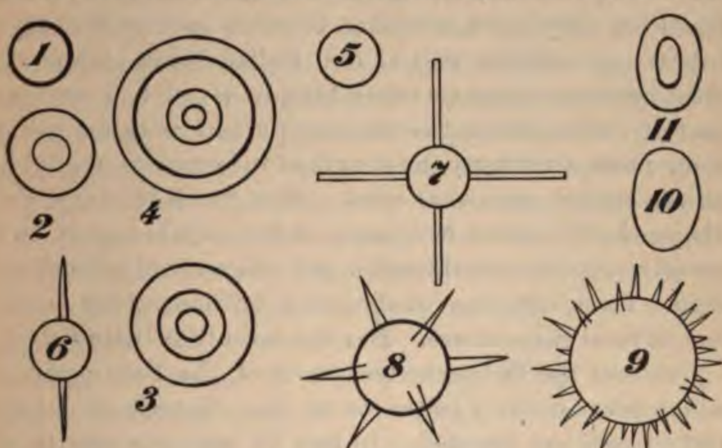
NUMBER 28. NEW SERIES.

Helps toward the Study of the Radiolaria.

By FRED'K B. CARTER,

MONTCLAIR, N. J.

The study of the Radiolaria is somewhat perplexing at first owing to the fact that the subject is so entirely new to most microscopists that they are unacquainted with the terms which are used in describing them. It is quite different in this respect from the study of the Diatoms for



example. When one first attempts that study he is already familiar with many of the terms from having read so much about them. But the man who takes up the Radiolaria has not read much about them. In fact there has not been anything for him to read worth speaking of, not

NOTE—The diagrams are not drawn to scale and give no idea of the size of the forms they represent.

a single book in English at his command that he could turn to for any definite information. Ehrenberg's work is in German, and while the illustrations are most valuable, the text gives no descriptions of genera or species but is confined to notes on the geology of the subject and to references to the different localities. Mrs. Bury's atlas is merely a collection of plates without any text. Hæckel's Monograph on the Radiolaria (1862) is also in German.

It is true his later magnificent work on the Radiolaria is in English but has not been at the command of the student owing to the price, about forty dollars, and few would have known where to find a copy even for occasional consultation. There is a copy in the Astor Library and I believe there is another in the Library of Columbia College, but beyond these two I know of no others in public libraries in and around New York. Unless I am very much mistaken it is not in the Brooklyn Library or even in that of the Philadelphia Academy. Most amateurs have recourse simply to such a work as that of Carpenter on the Microscope and nothing could show more strikingly the dearth of information available on the subject than that work. For the Radiolaria are disposed of in about five pages of text of which only two are given to the classification and they afford almost no help. I am speaking of the sixth edition which is the one in most general use. But the seventh is little better.

Contrast the elaborate treatment of the Foraminifera which takes up fifty pages or of the Diatoms to which forty pages are devoted. In fact it was this dearth of available information, which led me to write the series of articles on the subject which have appeared during the last three years in the Journal. But even when the information is given there is another difficulty, namely the large number of terms necessary in description owing to the astonishing variety of form presented by the Radiolaria. So that even with the key before him the stu-

dent may still be at a loss as to precisely what is meant by this or that character. And so it has seemed to me that it would be helpful to illustrate the key by some diagrammatic figures which would bring before the eye simply the principal characters which occur in the course of the classification. The diagrams are very rude but they will answer the purpose. They are not intended to represent any particular species but merely to give a general idea of the structure in each case.

I shall assume then that the reader knows nothing whatever about the classification of the Radiolaria but is simply acquainted with their general appearance as he has seen them on a slide of Barbadoes earth in balsam. Let us suppose him to have such a slide before him and to be able to identify the forms as far as the genera are concerned. How shall he go to work?

The first thing to do is to find out whether the form which is under observation is spherical (or approximately so) and has no single large opening, or whether it has the shape of an egg, cone, or bee-hive with a large opening at one end. Let us suppose that the former is the case. Now that puts it in the Legion Spumellaria and limits him to that part of the Key. Look again therefore, and see if the shell is a true sphere, or an elongated sphere (prune-shaped), or a flattened sphere (disk-like). We will say it is a true sphere. Then it belongs to the order Sphæroidea. What now about spines radiating from the surface? Is the form free from them like fig. 1? That places it in the Family Liosphærida. Now is the sphere hollow? It belongs to division A. Put on an ⅛th objective and if the surface is smooth it is Cenosphæra; but if the pores project in the form of little tubes just a trifle beyond the margin it is Ethmosphæra. But perhaps as you focus down on your sphere you find it is not hollow but that there is another sphere inside, like fig. 2. Then it is div. B, Car-

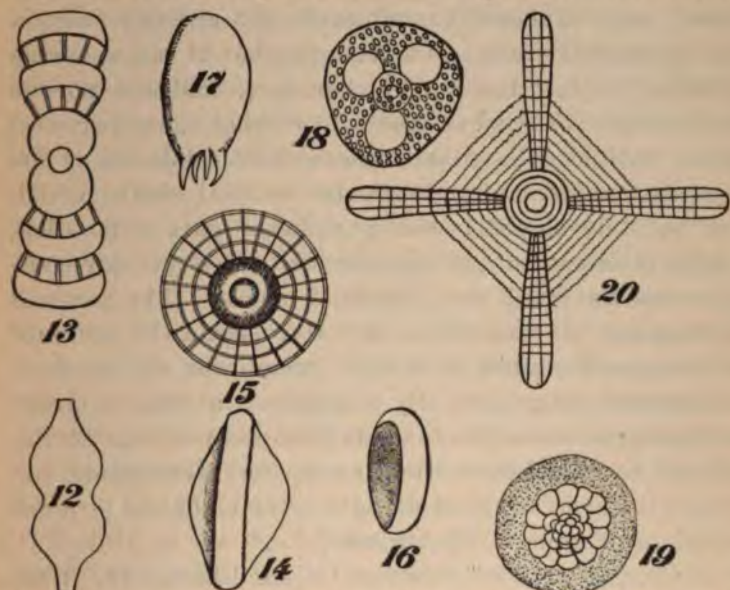
posphæra. Or there may be two spheres inside like fig. 3. Then it is div. C, either Rodosphæra or Thecosphæra, and if the two inner spheres are close to the centre it is the latter. If on the contrary one inner sphere is close to the outer shell it is the former. Possibly you may detect three spheres inside like figure 4, or even four spheres. In the first case it is Cromyosphæra, in the second, Caryosphæra.

But suppose it has spines, what then? Why mark the number and how they are placed. Are there two, opposite, like fig. 6? Fam. Stylosphærida. Four, forming a cross, like fig. 7? Fam. Staurosphærida. Six, opposite in pairs, like fig. 8? Fam. Cubosphærida. Eight to twelve or more like fig. 9? Astrosphærida. Take one more look to see whether the sphere in each case is single or has other spheres inside and the rest of the Key will explain itself, the only genus needing any note being Saturnalis, which looks like fig. 6 with a circle drawn around it so that the tips of the spines would just touch the circumference.

However, your form may not be a true sphere, a section of which would be like fig. 1, but ellipsoidal, a section of which would be like fig. 10. If so it belongs to the Order Prunoidea. Is the margin entire, like fig. 10, or has it a constriction, like fig. 12, forming two chambers, or several constrictions, forming four or more chambers like fig. 13? Then it belongs respectively to div. A, or B, or C, of that part of the Key which treats of ellipsoidal shells. If A, is it hollow like fig. 10, and is the surface latticed or covered with pores? Fam. Ellipsida. And the genus will depend on the absence or presence of spines and the disposition of them. Or has it an inner shell like fig. 11? Druppulida, and the Key will readily give the genus, the only explanation needed being that the medullary shell is the inner as distinguished from the outer which is termed the cortical

shell. Or is your shell spongy, the surface a mass of confused meshes instead of regular pores? Fam. Spongurida. Here again the only note necessary is that a latticed medullary shell is an inner shell with pores. If your shell belongs to div. B, or div. C, you will find no difficulty with the genera.

But instead of being a true sphere or an elongated sphere, your form may be a disk more or less flattened. Focus on it carefully and see which figure it more resem-



bles, No. 14, or 16. That is, if it were tilted would it show such protuberances as those in fig. 14 or lack them like fig. 16? If the form is a phacoid shell, resembles in shape a bi-convex lens with broad edges, it belongs to div. A. of discoidal shells, in which there are two families, the Phacosdiscida and the Coccodiscida. If the margin of the phacoid shell is simple, or only armed with radial spines, it is one of the former, and the number of the spines, and of the inner shells, and the presence or absence of a girdle will give the genus. By this

girdle what is meant is that the shell loses its convexity and becomes flattened at the margin. Imagine a bi-convex lens turned edgewise and a ring of thin glass encircling it in the equatorial plane and you will understand what is meant by the "hyaline equatorial girdle" of Periphæna. If on the contrary the margin of the phacoid shell, when only one surface is presented, is surrounded by concentric chambered girdles or rings it belongs to the Coccodiscida. "Each of these chambered girdles," says Haeckel, is composed of a circular ring in the equatorial plane, a variable number of radial beams dividing it into incomplete chambers, and two porous cover-plates or "sieve-plates," covering the upper and lower face of the disk. These sieve-plates may be regarded as incomplete lenticular cortical shells, which are only developed in the peripheral part of the disk, whilst their central part is represented by the only complete cortical shell, the "phacoid shell." The general appearance is that of fig. 15. Here again the presence or absence of spines or arms or membrane will serve to distinguish the genus. By chambered arms are meant such projections as the four club-shaped portions of fig. 20, and by membrane the fine spongy framework between the arms in the same figure, the technical term for which membrane is "patagium."

If your form is not like fig. 14 but like fig. 16, it belongs to div. B. In this division there is no "phacoid" shell, but a flat discoidal shell. There are two families in this division, the Porodiscida and the Spongodiscida. In the former, instead of a phacoid shell, there is a small simple central chamber surrounded by a number of small latticed chambers of nearly the same size and form (Haeckel). The surface of the disk on the two flat sides is covered by a porous sieve-plate.* In the first section there are neither spines nor arms nor any wide

*Challenger Report.

openings on the margin. Of the two genera, Perichlamydium is characterized by a thin solid equatorial girdle which Porodiscus lacks. In the former also the chambers surrounding the central chamber look more like a mulberry-mass of cells than a series of rings, and the form presents the general appearance of fig. 19. (In this figure the pores over the central and surrounding chambers are not shown). In the next section there are still no chambered arms or radial spines, and the main characteristic in the genus from Barbadoes is a single opening on the margin which is surrounded by spines. The nature of the openings is shown in fig. 18 which, however, represents a genus not found in Barbadoes which has three of these openings and no spines. Fig. 17 gives some idea of the outline of the Barbadoes form and of the opening and spines. In the next section there are no arms and no openings but radial spines, the number of which, together with the presence or absence of a girdle serves to distinguish the genera. And in the last section there are chambered arms, the number and disposition of which, together with the presence or absence and the disposition of a patagium or membrane, form the distinctive marks of the genera.

Finally in the Spongodiscida the sieve-plates disappear, and the shell is more or less spongy in character. The simple spherical central chamber sometimes has concentric rings around it but the surface of the disk shows an irregular spongy framework.

This finishes the Spumellaria. Next we come to the Nassellaria.

To be continued.

Focusing Upward.

By R. H. WARD, M. D.,
TROY, N. Y.

It is often advised to focus downward towards the slide, using great care not to go too far, until the object is actually seen. More prudent advice would be to set the tube too low for its focal distance, in every case, while observing it from the side by looking through, horizontally towards the light, between the objective and the slide, and then find the object by focusing upward while looking down the tube. After this, the whole thickness of the object can safely be examined by focusing slowly, and in many cases almost constantly, through it, forward and backward.

Some experts of great experience, prudence and self-control, persons of microscopic touch, and to whom caution and accuracy have become instinctive, may find the focus in almost any way, scarcely knowing or caring how. One of the commonest of these expedients is, while working the rock with one hand, to feel the way with a finger of the other hand, touching lightly the side of the objective at its lower edge, while the same finger or the next one, according to circumstances, projects downward to touch lightly the top of the slide. This gives a positive, and for low and medium powers, a sufficiently accurate knowledge of the varying distance from the objective to to the slide. But some of those heedless persons who, with the best of intentions, are always doing something wrong, until their suffering friends are strongly tempted to wish they were enemies instead, will either push the slide off from the stage to be broken by the fall, or else misjudge the indications of their touch until they hear the glass cracking under the pressure of the objective, when they will exclaim, more truly than they mean, "Oh! I didn't think——."

To nearly all beginners, and to an uncertain proportion

of others, the looking for an object while focusing down toward it is far from safe; at least, that is the result of the writer's observation during thirty-eight years of continuous and earnest attention to microscopy. But an inch objective is used far away from the slide, and at a perfectly safe distance? So is a three-inch, several times as far away; yet the writer has seen a highly cultivated man and experienced microscopist, in the midst of his best years, drive a 3-inch objective, with a crash that was heard throughout the room, through a unique and priceless slide—belonging to somebody else. But he was a stupid blunderer? Well, that is what *he* said, with manifest disgust and contempt, and he ought to know; in fact he abjectly announced his resolution to devote the blighted remainder of his worthless life to the fitting penance of eating all the "humble pie" that the spectators would condescend to prepare for his sanctification. But this is the world we are living in at present, and such acts of farce-tragedy are common enough to recur to anybody; as evidently they did to Dr. S. when he wrote of a tin cell that was too thick to be pleasing. "However, the cell serves one good purpose; the diatoms cannot be crushed between cover glass and slip unless a very strong hand is wielding the coarse adjustment."

The only safe rule that can be followed without being sorry sooner or later, is, *never* to find the object by focusing downward, and, *never* to allow anyone else to do it with your apparatus or objects. If one must focus downward, which seems temptingly easy, but in the end is the most difficult and tedious way he should do it with his own things; so as to make sure of the benefit of the scolding which politeness will hardly prevent his giving to himself when the first (and last?) accident happens.

This method of finding the object is applicable to even moderately high powers, of moderate angular apertures; using the foreign particles too freely present on the top

or bottom of the cover-glass, or top of the slide, or in the mounting medium, or the imperfections of the glass surfaces themselves, or in the cut edge of the cover, as a clue for locating approximately the plane of the object—which may be unexpectedly difficult with very minute transparent objects, such as a very few small diatoms or slightly stained bacteria or, still worse, very fine micrometer rulings.

With extreme apertures, or where the objective, suitably corrected, may nearly or actually touch thc cover, the greatest skill is requtred, and some danger exists even in the best hands. Even then the lens can usually be set as described above, so near that a glimpse, probably vague and distant, can be gained of almost anythıng coarser than the fine rulings or bacteria; when an upward touch of the ffne adjustment will either reveal the object distinctly or show that it is farther below. In the later case, while the fine adjustment is being lowered with extreme care, the slide may be frequently slipped upon the stage by the hand, over a distance which is a very small fraction ol the field of view (with a tolerably steady hand there is no difficulty in moving it as little as 1-20 mm., or 1-500 inch), in order to detect, by the increased resistance, any pressure of the objective before it becomes destructive. Or, if the hand be steady, the near side of the slide may be held gently down against the stage, and, the spring clips if any, being turned aside, the far edge of the slide be lifted by one of the finger nails until the now slanting cover-glass touches one edge of the mounting of the objective. This can be done with ease when the distance is less than the thickness of a sheet of paper; it furnishes deffinite idea as to the distance, and gives ample warning as that distance decreases and disappears. As the available focal distance varies with the screw-collar adjustment, it is well, with suspiciously thick covers, to adjust for maximum distance for finding the object, and

then reduce the adjustment until best definition be secured or be proven to be impracticable; as the lens when set for a minimum depth might rest upon the cover, while the object was still out of sight directly below the field of view. It is folly for any but the experts to attempt such work, and they will generally be wise enough to prefer doing it over their own slides.—*P. M. Club.*

What are the Bacillariaceæ.

By ARTHUR M. EDWARDS, M. D.
NEWARK, N. J.

As I have proposed to change the name Diatomaceæ to Bacillariaceæ I will say why that change should be made. The name is not a new one. To explain why it is proposed to renew it, I quote from the Rev. Eugene O' Meara in his Recent Researches on the Diatomaceæ (Vol. XII, n. s. of the Quarterly Journal of Microscopical Science, 1872, page 240, reprinted from the Journal of Botany, March and May, 1872.) Therein he says: "The name Diatomaceæ has been used by nearly all of the recent authors to designate this group. Rabenhorst, in his more recent work, has adopted the name Diatomophycæ, but in his former treatise used that of Diatomaceæ, "die Susswasser Diatomaceen;" and in this he has been followed by Gmelin, Heiberg, Shumann, Cleve and Suringar. Dr. Pfitzer, however, mentions that the name Bacillariacæ should be substituted, the genus Bacillaria having been established by De Candolle in 1805; and some of the older writers on the subjects have used this designation. It may be deemed inconvenient now to abandon the name of the group which has been so generally adopted, but on technical grounds, Dr. Pfitzer's view is undoubtly correct."

So it happens that the organisms which were called Diatomaceæ are now and should be called Bacillariaceæ. Popular observers who are not students may still call

them Diatoms, which is the English of the scientific Latin Diatomaceæ. So they may call Bacillariaceæ Bacills. But Diatoms are the siliceous shells, or loricæ of the perfect organism. The organism itself is a mass of protoplasm which secretes within itself the Diatom, just as shells are the loricæ of Mollusca and bones of man, so that when observing Diatoms we are not studying Bacillariaceæ. To study them requires time and patience. We can observe Diatoms and mount them to show them but that is very different from studying them. To study them, the observer must be a microscopist of no mean character and know biology, the science of plants and animals. He should be a physicist besides, and this requires time and patience. An observer may see the diatoms when looking at about one hundred slides but the student of the Bacillariaceæ has to spend many hours of patient toil to work out even the outline of one Coscinodiscus. Pleurosigma angulata requires many observations on specimens from various localities.

The Bacillariaceæ are not animals nor vegetables but possess characters that have induced Hæckel and other observers to rank them along with other organisms temporarily in a kingdom by themselves, in the Protista. But kingdoms are only transitional and they but items of the lowest organisms. Low because they carry on their life in a simple manner. And because they are so simple they are not affected by what we call evolution. Those that first existed in the Laurentian are the same as grow now. Epithemia turgida of the Silurian age is Epithemia turgida of the recent.

Students must not forget that Bacillariaceæ is but a name for organisms which are seemingly simple in character and bye-and-bye we may have to record complex things that they do and mighty work that they accomplish. They are simple when viewed by present knowledge, but they are mighty when viewed by the results.

THE MICROSCOPE.

New Series, 1893.

For Naturalists, Physicians, and Druggists, and Designed to Popularize Microscopy.

Published monthly. Price $1.00 per annum. Subscriptions should end with the year. The old series, consisting of 12 volumes (1881–1892), ended with December, 1892. Sets of the old series cannot be furnished. All correspondence, exchanges, and books for notice should be addressed to the Microscopical Publishing Co., Washington, D. C., U. S. A.

CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

Lighton's Stained Diatoms.—It was with much regret that we received lately a letter from a subscriber who complained that the slides he had purchased from Prof. Lighton were " not fit to be placed in any cabinet." He indignantly demanded from Prof. Lighton the return of his money and reported the matter to us. We have made some investigation and have letters of four other purchasers before us, from which we conclude as follows:

Prof. Lighton's material was not perfectly cleaned and as a consequence a certain amount of rubbish has been mounted with the diatoms. But that he has succeeded in staining the diatom shells in a satisfactory manner is well established. This is, however, not a new discovery. Dr. Edwards stained them many years ago. Lighton uses the aniline dyes. Edwards confirms this method, and says he tried haematoxylin and Prussian blue unsuccessfully.

No other fault has been found with Lighton's mounting and the reason why the purchaser would not put the slides in his cabinet was, as he said, that his cabinet was not a place for "stained dirt." Prof. Lighton claims to have returned his money to him by registered mail and we have not heard to the contrary. He ought next for neatness sake to learn how to clean diatom material, and to avoid occasion for controversy. The complainant, however, has been too severe and attempted to

create unnecessary alarm. Curiously he is the Judge of a court. We should hate to be tried before him.

We think the above explanation does exact justice to both parties and can be relied upon by others who have any idea of getting stained diatoms. Should further developments put any different aspect upon the matter we shall regard the public interests as paramount to those of Lighton, the purchaser or even of ourselves. We shall discontinue the advertisement the moment any dishonest proceedings develop. Our favor will not be bought with money, advertising or other considerations. We have fallen upon evil times and deceptions abound. We lost a subscriber last year by telling the truth about his book. We can spare one or two more on the same terms, if need be.

PRACTICAL SUGGESTIONS.

BY L. A. WILLSON,

CLEVELAND, OHIO.

Making Sections of Coal.—In the February number of the Microscope an article under the above title was published. The recipe or process though taken from a standard authority seems to be open to objection. The process there published is said to be applicable to lignite only. For coal, I abstract the following process from Acadian Geology, by Dawson, p. 493 *et seq.*

The vegetable nature of coal may be seen by closely inspecting the surfaces of a lump of the mineral with the aid of a bright light and a magnifying glass. For the microscope, results have been obtained, more particularly, with mineral charcoal. Select specimens containing the tissues of a single plant.

Fragments or portions of stems of this character can be obtained by careful manipulation from most coal. Place the pieces to be examined in marked test tubes, treat them with strong nitric acid, heat to the boiling point and keep in that condition so long as dense fumes of nitrous acid are disengaged, or until looking through the tube, the material can be seen to have a brown color and a certain degree of transparency. In many cases, boiling in this manner for a short time is sufficient to render the fibers flexible and as transparent as slices of recent wood when slightly charred.

When ready for examination, the charcoal should be allowed to settle, and repeatedly washed with pure water before removing it from the tube. It should then be examined in water, with powers of from 50 to 500 diamaters and may then be dried and mounted in balsam. Some refractory specimens require alternate washing and boiling in nitric and hydrochloric acids before their structures can be made out. The process here indicated does not produce a siliceous skeleton of the coal, but removes the bituminous matter which is oxidized and dissolved by the acid, and the mineral matters especially the sulphuret of iron, which is one of the principal causes of the brittleness and opacity of the crude mineral charcoal.

Mineral charcoal is also known as fibrous coal, fossil coal, mother-of-coal and is a soft black substance resembling charcoal in appearance found in connection with coal, usually along its planes of stratification or lamination in which the woody character of the material from which the coal was formed is more perfectly preserved than it is in the body of the coal itself.

In Dana's Manual of Geology it is said that even solid anthracite has been made to divulge its vegetable tissues.

Another method of examining coal is to grind the coal to a fine powder and examine the fragments. Only the finest powder will show structure. This plan is unsatisfactory.

Another method is to burn the coal to a white ash and examine it under the microscope. This ash often exhibits perfect skeletons of vegetable cells, but these are fragile and require great care in their management. They should be first soaked in turpentine and then mounted in Canada balsam.

Section of Water Lily.—A section of the stem of the water lily (Nuphar Advena) double stained, will make one of the pet slides of a cabinet.

The section cut near the joint or across the petioles makes the prettiest mounts, as they are composed of different kinds of cells, the usual parenchyma and of stellate cells, each of which will take a different stain. When well cut and properly stained they will make a slide of which any microscopist may be proud.

Beal's Carmine Staining Fluid.—The following formula will be useful:

Carmine...10 grains.

Strong liquor Ammonia	½ drachm.
Glycerine	2 ounces.
Distilled water	2 ounces.
Alcohol	½ ounce.

Cell Culture of Fungi.—Most kind of fungi especially the blue mold found on bread and on top of preserves may be cultivated in cells and conveniently examined in these cells with the microscope. The following is copied from Bessye's Botany, page 240.

The most accurate and satisfactory, but at the same time most difficult cultures, are cell cultures. They are made as follows :—glass, tin, or India rubber rings four to five millimetres high are fastened to ordinary glass slides; a very little water is placed in the bottom of the cell so formed, to keep the air in it always moist; a small drop of the nutrient liquid, free from spores of any kind, is placed in the middle of a cover glass of the proper dimension, and in this a single spore of some particular mould is placed; the cover glass is now inverted over the cell. The preparation must be placed in a warm and saturated atmosphere. An ordinary bell-jar set over a plate of water, or better still, of wet sand will furnish a very good moist chamber.

Nutrient fluids are as follows :— First, boiled and filtered orange-juice; second, a decoction of horse-droppings boiled and filtered; third, a saline solution as follows:—

Calcium, nitrate	4 parts.
Potassium phosphate.	1 part.
Magnesium sulphate	1 part.
Potassium nitrate.	1 part.
Distilled water.	700 parts.
Sugar	7 parts.

In some cases the sugar may be omitted.

SPECIAL NOTICE.

Radiolaria material.—Those who are sufficiently interested in Rev. F. B. Carter's article on pages 49–55, to wish to study the subject can obtain some material by addressing him at Montclair, N. J., and enclosing stamps.

THE MICROSCOPE.

MAY, 1895.

NUMBER 29. NEW SERIES.

Objects Seen Under the Microscope.

BY CHRYSANTHEMUM.

XXIII.—RED SPIDER (GAMASUS TELARINA).

This little spider is found on rose-bushes and is so small as to be seen with difficulty without the aid of a glass. Its presence is detected by the sickly, yellowish and mottled appearance of the leaves. If the under side of one of these leaves be examined a minute silken web will be found.

Examine carefully any little red or yellow spot on or near this and by touching it with a dissecting needle perhaps one of the spiders may be seen running about. Try and induce it to run upon a slide or cover-glass. This is a difficult thing to do as its feet are not made to walk on smooth surfaces, but with a little patience and the aid of a dissecting needle it can be accomplished. To kill them, proceed as with the Aphis, (see Mar. No.) but more alcohol is required, or coal oil may be used. This requires some time to evaporate. Great care must

be taken for they are so delicate that their parts are easily displaced. It may be well to look at one while it is still alive. If an adult, it has an oval body, Fig. 1, four pairs of legs and two mandibles, (Fig. 1 n.), but it has no eyes. It is not a true spider, neither a true insect, but belongs to the same family as the mites (Acarina). Its body and legs are furnished with hairs which are long and very sensitive, those on the feet having a nub at their extremities, making them look like little pins stuck into the feet, Fig. 3. On the under side of the body near the end of the abdomen is the rounded protuberance from which the silk is produced. By the aid of the claws and the hairs on the legs this silk is spun into so minute threads that it takes a high power to distinguish one thread from another. By the united effort of many spiders, tents are formed of this silk and suspended from the hairs on the surface of the leaf. These insects thrive best when it is hot and dry. They use the tents as protection from cold and dampness, and also as a place to deposit their eggs. Although so tiny, they lay a spherical, colorless, transparent egg, which produces larvæ like the parent, except that it is smaller and has but six legs. The larvæ are usually white, while the color of the adult varies from deep red to yellow, green or mottled according to the color of its food. They feed on the juices of plants, piercing the leaves with their jaws, (Fig. 2 s) and extracting the juices with their barbed suckers (Fig. 2 t). Fig. 4 is a dorsal view of a red spider found on the cotton plant. It is also found on the Canna.

To destroy them wash the under side of the leaf with a mixture of 100 parts water, 6 parts soft soap and 6 parts quassia, steeped in water, or coal oil may be substituted for the quassia. If the plant be taken into a cool room for a few days the insects will die.

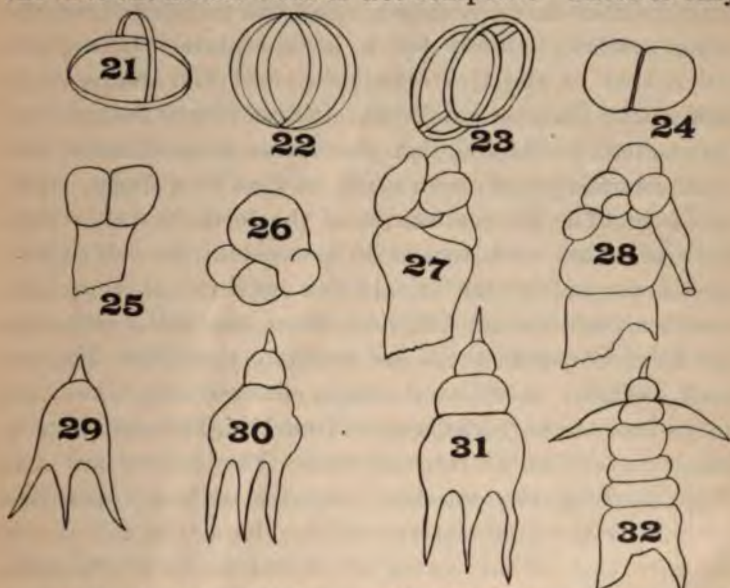
Helps toward the Study of the Radiolaria.

By FRED'K B. CARTER,

MONTCLAIR, N. J.

(*Continued from page 55.*)

In the Nassellaria or Monopylæa, the fundamental form of the central capsule is egg-shaped instead of spherical, and the pores, instead of being distributed all over it, are confined to one area, and the skeleton has the shape of an egg, cone, or bee-hive, with one large mouth or opening. Here are two main divisions. In the first the lattice shell is not complete. There is only



one order in this division, so that if the form consists of a ring or of several rings (see Figs. 21-23) it belongs to the order Stephoidea which means, like a crown or wreath. In the Fam. Stephanida there is only one ring and the genera are thus distinguished :—Zygocircus has simple spines, while in Dendrocircus the spines are branched, giving the appearance of foliage : Cortina and

Stephanium are marked by basal feet or long, thick spines, the former having three, the latter four. In the Fam. Semantida there are two rings (see Fig. 21), one horizontal, the other joined to it in a vertical position. Cortiniscus and Stephaniscus have feet on the horizontal ring, the former three, the latter four. The other genera lack such feet and are separated by the number of pores inside the horizontal ring. The student might suppose that in such cases the forms had no single large opening and were therefore not Nassellaria, but the space inside the basal ring is regarded as such, as it is found entirely open in other genera, and the mouth is assumed to be partially closed by a lattice plate. In another order, that of the Cyrtoidea, we shall find the pores in this mouth plate so small that at first it will be hard for the student to distinguish the forms from those of the Spumellaria by any such mark as that of a single wide opening. The general shape of the form, however, will show him that such forms do not belong to the Spumellaria, the end which is said to have a mouth closed by a lattice plate being different from the other end. In the Fam. Coronida there are also two rings, but they are both vertical meridional rings, intersecting like two hoops crossed at right angles (see Fig. 22) and there is usually a horizontal ring as well. The genera are distinguished by the number of gates or large openings formed by the intersections of the rings. In Podocoronis only two of the gates are basal, in Tristephanium four, the others, in each case, being lateral, that is openings made by the intersection of the vertical rings. In the Fam. Tympanida there are two parallel horizontal rings (see Fig. 23) and these are connected by a vertical ring and sometimes by two vertical rings or more. The joinings of these horizontal rings are also called columellæ or little columns. Microcubus has four of these

columns, that is the horizontal rings are connected by two vertical rings. Tympaniscus has six columns or three vertical rings, and Tympanidium eight columns or four vertical rings. The student should understand that these vertical rings are incomplete, and that the little columns are supposed to represent segments of such rings, in other words that if vertical columns (as in Fig. 23) were produced and united above and below where they join the horizontal rings they would form a complete vertical ring.

In the second division of the Nassellaria the forms have a complete shell, and the shell is latticed, that is has pores. Here are three orders which are distinguished by the form of the cephalis or first joint. In the first order, the Spyroidea, this cephalis is bilocular, that is, it is divided into two chambers by a middle partition,(see Figs. 24, 25). The Fam. Zygospyrida consists of those forms which have only a cephalis (see Fig. 24), in other words there is no second joint or thorax as it is called. The genera are divided into sections by the number of basal feet, the last section lacking them altogether, and are still further separated by the number and disposition of horns or the absence of them. In the Fam. Phormospyrida, besides the cephalis there is also a thorax, that is, the shell consists of two joints (see Fig. 25) the cephalis being the upper, the thorax the lower. And in the Fam. Androspyrida the cephalis has an apical cupola, or little dome at the top.

In the second order, the Botryodea, the cephalis is multilocular, that is consists of several chambers, and their appearance is that of lobes, (see Figs. 26-28). The forms of the Fam. Cannobotryida have only the cephalis, (see Fig. 26), while those of the Fam. Lithobotryida have a thorax, or second joint also, (see Fig. 27). Here we meet with the distinction, mouth closed, which I

spoke of a page or two back. The genera Lithobotrys and Botryocella instead of lacking a mouth, as would appear at first sight, are said to have the mouth closed. It will puzzle the beginner to find any trace of a mouth in the shell, and he must accept the fact on the authority of Haeckel who gives us this distinction. At the same time he will readily recognize the general resemblance of these forms to all the rest of the Botryodea by the presence of the peculiar lobes, and as many of them have a mouth it will only require a slight stretch of the imagination to believe that in these forms the mouth has been closed by an abnormal growth of the lower part of the shell. At any rate they do not at all resemble the Spumellaria in shape, and if we had the living forms before us, we should undoubtedly find that the openings in the capsule (the inner portion of the protoplasmic body of the animal), were confined to the area facing what is called the closed mouth. In the last Fam. of this order, the Pylobotryida, the forms have three joints, cephalis, thorax, and abdomen (see Fig. 28), the abdomen being simply the lowest joint of the three.

In the last order, the Cyrtoidea, the cephalis is simple, that is, it consists of only one chamber, (see Fig. 29). It has no internal partitions, dividing it into two chambers, as in the Spyroidea, or into many lobate chambers, as in the Botryodea, and the general shape of most of the forms is that of a cone. This is an immense order, comprising no less than 79 genera. But it is divided into four sections, which are very clearly distinguished by the number of the joints in the shell, thus :—

Section A, one joint—Cephalis only ; Fig. 29.

Section B, two joints—Cephalis and thorax ; Fig. 30.

Section C, three joints—Cephalis, thorax and abdomen; Fig. 31.

Section D, four to seven or more joints in the shell ; Fig. 32.

By bearing these distinctions carefully in mind the student will be able very quickly to assign any of these forms to the proper section, and then the determination of the family and genus will occasion very little difficulty.

Thus in each of the sections, we have three families which are separated by the presence or absence of what are called radial apophyses (or outgrowths) that is, ribs, wings, spines, or feet. And these three families occur in the same order in each section, so that we meet with these characteristics over and over again, namely, three radial apophyses. Take for example, section A, in which the forms have the cephalis only. The Fam. Tripocalpida has three radial apophyses, which in this family are feet, and the presence of lateral ribs or ridges distinguishes the genus Tripocalpis from Tripilidium. The Fam. Phænocalphida has numerous radial apophyses, which in this family also are feet, and the genera are distinguished by having the mouth open or closed and by the presence or absence of radial ribs or ridges and a horn. The genus Phænocalpis may also be recognized by the presence of a slender column in the axis of the shell cavity. And the Fam. Crytocalpida has no radial apophyses. The key to the genera here is so plain as to call for no comment.

Now these main distinctions run through all the sections. Thus in section B, in which the forms have two joints, both cephalis and thorax, the first Fam. Tripocyrtida starts off as before with three radial apophyses, which in this family are either ribs or wings or feet. In the first division the mouth of the thorax is open. Where the ribs are said to be enclosed in the wall of the thorax, what is meant is that they do not simply appear on the outside of the thorax but are built into it. By a latticed thorax is meant one with pores. The peris-

tome is the circle formed by the mouth of the shell. Where the feet or spines are said to be solid, what is meant is that they have no pores. Wings are only broadened spines and in several of the genera they are so slightly broadened that they are just stout spines and nothing more. But standing out as they do from the sides of the shell, they are called wings because of their position. In the Fam. Anthocyrtida again, there are numerous radial apophyses as was the case with the second family of section A. The only thing in the key to this family that needs to be explained is that when the meshes are said to be simple, the meaning is that the spaces between the meshes are open. Fenestrated meshes are those in which the spaces are partially filled by a fine net-work. And in the Fam. Sethocyrtida we have no radial apophyses, as was the case with the third family of section A.

Again, in section C, in which the forms have three joints, cephalis, thorax and abdomen, we have exactly the same order for the families, Podocyrtida having three radial apophyses, Phormocyrtida numerous radial apophyses, and Theocyrtida none. The abdomen is the third or lowest joint. Remembering that horns are spines on the top of the shell, (see Figs. 29-32) wings, spines on the sides (see Fig. 32) and feet, spines on the bottom (see Figs. 29-31), the key to the genera will be readily understood, the only other point needing explanation being that simple feet are those which as in Figs. 29-31 are not forked or branched. When the feet are divided or forked they are said to be ramified. What the student needs to note carefully in these families is whether the wings or ribs are on the thorax, or partly on the thorax and partly on the abdomen or only on the abdomen. Horns of course will only be at the top of the shell and feet at the bottom.

Finally, in section D, there are from four to seven or more joints in the shell, (see Fig. 32). The first joint is still known as the cephalis, the second as the thorax, the others as abdominal joints, first, second, third, etc., the first abdominal joint being the one next the thorax. By a vertical basal spine is meant a spine on the last of the abdominal joints (which in such forms is closed), pointing in the opposite direction from that which a horn on the cephalis would take.

In conclusion let me say that the student should make some type slides for himself, if he wishes to get an idea of the classification. There are too many forms on a strewn slide for comfort. A type slide of 20 or 40 different forms will be the most convenient for study. The mechanical finger furnished by Bausch and Lomb is very handy for this purpose, but in place of the hair which is supplied with it I use a fine glass hair made from a small glass rod which has been heated in the middle over an alcohol lamp or a Bunsen burner. Just as it begins to melt, the two ends are drawn apart rapidly as far as the arms can reach, and the result is a long, fine thread which floats in the air. Let it settle on the table and cut off a bit of the thinest portion about half an inch in length. Then make a wedge of beeswax, rounded on one side, flat on the other, and press the hair on the flat side so that it projects beyond the wedge point about an eighth of an inch. Press the wedge on the steel rod of the mechanical finger and adjust the finger on the microscope and you are ready for work. In place of a glass hair, I have used a hair of sealing wax with much better results as the forms do not spring off from it as they do from glass.

The student will do well also to procure a copy of Ehrenberg's work, the title of which is "Fortsetzung der mikrogeologischen Studien, etc." Von Christian Gott-

fried Ehrenberg, mit * * * Tafeln, Berlin, 1875.

It must be imported, but can be obtained through Messrs. B. Westerman & Co., 812 Broadway, N. Y. The cost will be from five to eight dollars.

The Character of Agar–agar, and The Bacillariaceæ Found in Connection with it.

BY ARTHUR M. EDWARDS, M. D.
NEWARK, N. J.

Agar-agar or Bengal Isinglass is a vegetable product obtained in China from sea weeds: *Eudæmna spinosum*, *sphærococcus*, *licheneides*, *spinosus*, and *tenax*. These Algæ are bleached by the sun and put up in packages. They are almost colorless and look like and are vegetable gelatine. It is used as a medium for the cultivation of Bacteria and is purer than animal gelatine. It dissolves more easily in water also. It comes into commerce in transparent colorless strips, almost completely solubie in water and makes a large quantity of thick, tasteless, and colorless jelly. As dilute sulphuric acid dissolves it, forming galactose, which is characterised by its conversion into galactonic acid by oxide of silver, it is readily cleaned. Nitric acid dissolves it also. The siliceous Bacillariaceæ are then seen very plainly. It does not require boiling in other acids or Bichromate of Potassa but Hydrochloric acid and Bichromate of Potassa are desirable to thoroughly clean it. Washing with water and weak ammonia afterwards when we have the siliceous shells of Arachnoidiscus ehrenbergii clear and briliant. In this way we can get this Bacillarian from the China sea readily. I have also made use of this process on Agar-agar sent to me by Mr. Priest from Japan. It is called birds' nests in China because the sea birds use it in making their nests and it is used

by the Chinese in making a soup. Many years ago microscopists got the Arachnoidiscus from it. The Algæ are brought by the cura siwa or Japanese current to the west coast of North America and there the Bacillariaceæ are abundant. Aranchnoidiscus ehrenbergii is common in the mouth of the Columbia river in Washington and I have it from there sent to me by Miss A. L. Pollock. It is also common in the harbor of San Francisco where I gatherd it myself in 1877, and on the coast until we come to San Diego where it is common.

And this brings me to the statement that Arachnoidiscus ehrenbergii J. W. B. is the only form or species of the genus, the others seeming different but not being realy so.

There are eleven forms or species of Arachnoidiscus, some from recent gatherings and some from fossil, some from California, New Zealand, Barbadoes and Spain but all the same.

It was called by Ehrenberg, Hemiptycus but this name was used for a genus of insects and so Arachnodiscus was adopted. It is named from its looking like a spider's web. There are also present in the Agar-agar specimens of Grammatophora marina FTK and Cocconeis scutellum C. G. E. and Cocconeis pseudomarginata A. G. which I am disposed to think is a variety of C. scutellum. At all events the Bacillariaceæ are scarce in the agar-agar. Spicules of sponge are also found.

Vaselin in Microscopy.—Gawalowski proposes to replace cedar oil and other liquids used for oil immersion for objectives by vaselin, whose refractive index is 1.40.—*Rundschau.*

Fine Mounts of Caterpillars.—Mr. C. P. Bates, 853 Main street, Petaluma, Sonoma County, California, prepares fine mounts of Caterpillars. We advise those who are intereste d in the subject to correspond with him.

THE MICROSCOPE.

New Series, 1893.

For Naturalists, Physicians, and Druggists, and Designed to Popularize Microscopy.

Published monthly. Price $1.00 per annum. Subscriptions should end with the year. The old series, consisting of 12 volumes (1881–1892), ended with December, 1892. Sets of the old series cannot be furnished. All correspondence, exchanges, and books for notice should be addressed to the Microscopical Publishing Co., Washington, D. C., U. S. A.

CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

Remember the A.M.S. meeting at Ithaca Aug. 21, 22, 23.

Postal Club Vacancies.— We understand in reply to a question about new members, that the managers like to have the names of just a few (very few) to fill vacancies, but that they only need such as will become permanent members. Those who join from curiosity and soon drop out cause serious trouble by breaking up circuits and disaranging arrangements. A club must be a matter of mutual helpfulness and none should apply unless they can contribute in reasonable proportion to what others contribute and especially avoid making trouble by delay, indifference, etc.

Frank P. Peck, M. D.—He was pathologist of the State Insane Hospital at Mount Pleasant, Iowa, where he died June 26, 1894. While the duties of his professional position where chiefly microscopical, they naturally limited his work mostly to medical microscopy, especially in relation to nervous diseases; but he maintained an appreciative interest in the work of others in different fields. Having a genial character, as well as great literary and scientific ability, he was an esteemed and successful leader whose support and influence were always used freely in the interest of the Postal Club.

QUESTIONS ANSWERED.

Note.—Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of all grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.

223. *Where can I get Tuckerman's Lichens?*

Part I is out of print and cannot be got. Part II costs $2.50, postage 5 cents. We can place your order.

224. *Will you inform me if the silvered prism arrangement described in The Microscope, for Nov.* 1888, *has given good satisfaction? Where can one be obtained? F. C. Grugan.*

We have no information regarding the performance of the silvered prism described by Dr. Egbert. It seems to have been devised under the impression that a camera box must be placed in a horizontal position when in use. A camera can be easily supported and used in a vertical position, in cases where the microscope body cannot be inclined. The silvered prism seems to have been an unnecessary appliance and was not extensively used. Mr. Zentmayer of Philadelphia could make one.

PRACTICAL SUGGESTIONS.

By L. A. WILLSON,

CLEVELAND, OHIO.

A Cheap Substitute for Selenite.—The following, which first appeared in the American Journal of Pharmacy, will be of much interest:

Ordinary mica (the kind used in stove doors) furnishes a very efficient substitute for selenite. Select the clearest pieces, cut them to the desired shape, and slip them under the slide to be polarized. Of course the analyzer and polarizer must be in place. If the first view be not satisfactory give the mica a slight turn upon its axis and see whether in any position a satisfactory color is obtained.

When found, cut one end square so that it will be parallel

with the slide; by always slipping the mica in the same way, the same color will be obtained, as the color varies with the thickness. Quite a variety of beautiful color effects will be secured by either using mica plates of varying thickness or by merely using two or more layers of thin plates superimposed.

The colors will be varied still more by altering the relative position of these plates. Three plates of varying thickness will be all that are necessary to keep. If the first piece of mica selected does not suit throw it away and try another.

In Dallinger's Carpenter (seventh edition,) page 271 it is said: The variety of tints given by a selenite film under polarized light is so greatly increased by the interposition of a rotating film of mica that two selenites, *red* and *blue*, with a mica film are found to give the entire series of colors obtainable from any number of selenite films, either separately or in combination with each other.

Scales of Lepidoptera.--These may be exhibited in their natural arrangement by mounting a small piece of wing dry. If desired as test objects, a slide or thin cover, after having been breathed upon, may be slightly pressed on the wing or body of the insect.

Some scales as the poduræ, show a beaded appearance under high powers from corrugation. With a good wide-angled objective, these appearances may be resolved into exclamation points.

Stings and Ovipositors.—These objects present a great variety of structure and are best mounted in balsam. To obtain them, press upon the back of the insect until the organ is extended and while extended, sever close to the body with a sharp dissecting knife. They should then be transferred to oil of cloves for a short time, then to turpentine, and finally mounted in balsam.

Before mounting, it is best to examine them under a dissecting microscope and if not properly spread out, to spread them out well with needles.

Fixing Arranged Objects to a Slide.—A thin solution of clear glue dissolved in alcohol and spread upon a slide, is useful for this purpose. As each object is placed upon the slide,

breathe gently upon it and this will fix it permanently so that it may be mounted in balsam.

SCIENCE-GOSSIP.

Hydrophobia Treatment.—From 1890 to 1895 the Chicago Pasteur Institute treated 366 cases and lost but two by death, while 372 others who applied for aid were dismissed after it had been ascertained that they had been bitten by animals not rabid. Prior to Pasteur's discovery 88 per cent of persons bitten on the head died, 67 per cent of those bitten on the hands died, and 25 per cent of all others. About 60 per cent of those treated were residents of Illinois. Further information may be obtained by addressing Dr. A. Lagorio at the Institute.

RECENT PUBLICATIONS.

The Gospel of Buddah. By Dr. Paul Carus. Open Court Pub. Co., price $1.00.

Every one who has been brought up in the Christian religion and taught that it is the one only true religion; and who desires, instead of being narrow and conceited, to be broad and wise and generous would do well to read the Gospel of Buddah as many times, as reverently, and with the same motives with which he has read the Gospel of Matthew. Were there in this country one hundred thousand clergymen employed for ten generations and paid for sounding the praises of the Gospel of Buddah perhaps it would have a great deal more power upon the people than the Gospel of Matthew now has or ever has had. It is perhaps too much to hope that this book will receive the attention which it deserves.

Whist Made Easier. By Geo. P. Rishel, Hornellsville, N. Y. 23 pp. 35 cents.

One of the best recreations is a game of whist. No book extant gives the rules so compactly and intelligently as this. There is as much discipline in whist scientifically played as in tha study of Greek.

THE MICROSCOPICAL JOURNAL.

Contents for May, 1895.

THE MICROSCOPE.

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THE MICROSCOPE.

JUNE, 1895.

NUMBER 30. NEW SERIES.

Objects Seen Under the Microscope.

BY CHRYSANTHEMUM.

XXIV.—CRYSTALS.

The crystals of many of the salts in common use make very pretty objects when seen under the microscope and some of them are easily prepared. It is well to become acquainted with them. Take a little table salt, dissolve it in water and place a drop on a slide, spread

it evenly and let it dry. In a few minutes many square crystals may be seen (fig. 1 *m*). As a rule the longer the crystals are in forming the larger they will be. Alum treated in the same way gives crystals as shown in fig. 1 *h*.

Bicarbonate of soda, [common baking soda], when dissolved in cold water and allowed to dry slowly forms crystals like those shown in fig. 1 *s* and *t*. If dried by holding the slide over a lamp, the crystals are imperfect and much like the center of fig. 1 *s*.

To prepare a slide of sugar crystals dissolve a little sugar in water to form a thick syrup, spread it on a cover-glass and dry quickly over a spirit lamp. When dried put in a damp place for twenty-four hours, or more, when crystallization will have taken place. The

crystals should always be formed on the cover-glass when one wishes to make a permanent mount and every trace of grease must be removed by cleaning with liquid potassæ or ammonia immediately before using. Always very great care must be taken that none of the agent be left upon the cover-glass, as it may interrupt and change the shape or position of the crystals or even alter their form. The same crystals may present many different forms according to the conditions under which they are

formed. In fig. 1 *n* are some of the simplest forms of sugar crystals.

Some kinds of ink, if spread on a slide and allowed to dry slowly, produce crystals. Stafford's ink which had stood for some time produced the crystals shown in fig. 2, but a slide made of some recently purchased gave only a few crystals and those principally in toothed lines. This polarizes well.

Chlorate of potash makes a pretty slide. Dissolve some of the potash in a little water and spread a drop on a slide. Let it dry in a cool place and it will give tabular crystals (fig. 1 *k*). If a permanent mount is desired, dissolve some small pieces of gelatine in about as much distilled water, make a saturated solution of chlorate of potash, add a few drops to the gelatine and stir gently with a glass tube, being careful not to form bubbles, then spread a drop on a cover-glass. If in a cool place it will dry in about half an hour. If the crystallization has been successful a slide may give such forms as are seen in fig. 3. The crystals shown in fig. 4 were found near that shown in fig. 3 *b* but were so small as to appear simply as points of light with the same magnification as used in drawing fig. 3. Fig. 1 *i* represents one branch of a tree-like pattern which was found in another slide. To form these dentritic or tree-like crystals, heat a drop of the solution on a slide over a spirit lamp and as soon as the crystals begin to form at any point, tilt the slide so that the water will run off. Then continue the crystallization by gentle warmth. By comparing these different forms of this crystal it will be seen how easily they might be mistaken for crystals of different salts. Chlorate of potash gives fine colors with the polariscope.

Fig. 5 represents a group of sugar crystals taken from a slide which contained fifteen similar groups;

the edges seemed to touch but not over-lap. Around this central mass were a few of the simpler forms. With the polariscope sugar shows many brilliant colors.

To make a slide of tartrate of soda take a strong solution of tartaric acid and neutralize it by the addition of carbonate of soda. Spread this on a cover-glass and warm but not boil. This must now be laid in a dry place protected from the dust and in from two days to

two weeks some of the slides will prove beautiful objects. Some never crystallize. The one shown above polarizes so that on revolving the polariscope the colors revolve around each center like so many wheels.

Nitrate of uranium, in a solution of six parts water, crystallizes in rhombic forms, but from a solution three parts water containing much fine nitric acid it forms

florescent needles. The slide from which the one shown below was taken gave many needles and detached crystals arranged similarly to the small ones in the part giv-

en. There were several as large or larger than the largest part shown. It polarizes well.

Two salts may sometimes be combined with good results.

Diptheria Anti-toxine.

By C. HADLEY CARLSON, M. D.,
SAN FRANCISCO, CAL.

[Report of an address before the San Francisco Microscopical Society, April 16, 1895 by Wm. E. Loy, Secretary.]

Anti-toxine is a preparation from the blood serum of a perfectly healthy horse, into whose circulation has been injected the toxine of diptheria. It has long been known that patients who have recovered from infectious diseases exhibit a greater or less degree of immunity to future attacks; and for centuries it has been the custom to artificially infect with genuine smallpox, which running a comparatively light course, rendered the person so treated proof against future attacks of fierce epidemics. Vaccination, as now administered, consists in inoculation with an attenuated or modified form of the agent that causes variola. The discovery of vaccination is the

foundation on which rests that structure of modern genius—serum-therapy.

Workers have been unceasing in their efforts to discover protecting agents for other infectious diseases. The development of bacteriological science in the past twenty years has shown the essential etiological factor of many of these maladies. It was evident that in every disease in which a past attack protected the patient against renewed infection, there was exerted on the tissues an influence, either by the morbific agent or its products, which rendered it difficult or impossible for the germs to again flourish. Pasteur was the first to procure immunity from certain animal scourges, as anthrax and fowl cholera, using the method of inoculating them with attenuated cultures of the organic causative agent of the disease.

The second method of bacteric-therapy is entirely different. Behring discovered that in diphtheria and tetanus, substances that destroyed or counteracted the poison were found in the blood of immunized animals, and by these substances a preventative vaccination, as well as a cure of those already attacked, may be affected. These substances were found to be as specific as the living organism causing the disease and the poisons produced by them. The doctor then gave the various facts or points noted by Aronson, upon which facts this system of serum-therapy is founded, also Behring's summing up. Among these points of general interest to the public, it may be mentioned that larger doses of the anti-toxine are never injurious, but on the contrary can only be benificial ; that each blood anti-toxine is immunizing and curative only for one infection, and that as anti-toxines are soluble bodies, they may eventually be produced outside the living body, or even be compounded synthetically.

It is especially in diphtheria that the anti-toxine method has been extensively applied and its results carefully tabulated. Statistics have shown a reduction of the death-rate from about 40 per cent to 13 per cent in epidemics of equally widespread prevalence and virulence of type. Of all animals fit for furnishing anti-diphtheritic serum, the one most used is the horse. He is the most easily immunized ; bearing the toxine better than other animals, he is capable of furnishing large quantities of anti-toxic serum at short intervals, and his serum appears comparatively inoffensive to animals and man. The horses employed are carefully examined for evidence of organic disease, especially of the kidneys, and are subjected to an injection of mallein to ascertain if they have glanders. Their healthy condition being established, the injections are made into the skin of the neck or back of the shoulders. Having the animal brought up to a certain degree of immunity, the next step is to keep him there, or improve the strength of his serum by large doses of very virulent cultures. Finally, the horse having been found in a satisfactory condition, the blood is withdrawn from the jugular veins, through a sterilized canula, into sterilized vessels and allowed to separate. The resultant serum is then passed through an unglazed porcelain filter and transferred to sterilized bottles for use.

The Origin of Clays in New Jersey Containing Diatoms.

By ARTHUR M. EDWARDS, M. D.

NEWARK, N. J.

In the course of my perigrinations about New Jersey during the last four years, in searching for geological phenomena, I have observed phenomena which relate to the Bacillariaceæ. These wide-spread phenomena are known to microscopists alone. The geologists know

their value and how important a knowledge of the Bacillariaceæ is when studied this way.

I have gathered the clay in various parts of North Eastern New Jersey during the last four years. I had it collected and collected it myself in New Hampshire in 1873 and I had it from other spots in this country and abroad and I looked for a geological reason for the appearance of these so-called fresh-water, subpeat, or lacustrine sedimentary deposits known as Diatomaceous. I knew that they contained more or less of clay but I did not find out how they came geologicaly until now. I found them always to be associated with glacier ice.

This ice age is a rather recent phenomena but how long it lasted is not known. Suffice it to say that in the Eastern United States there was but one glacier extending from the pole to the 40th degree of parallel.

I have gathered clay from a point eight miles above Paterson city to New Brunswick and from the Hudson river to above Morristown and I found it always the same, resting beneath a thin covering about six inches to a foot thick of alluvial and about three feet to over ten feet thick upon the gravel, the red sandstone moraine of the geologist. This moraine is very thick, over thirty feet in some places. I have gathered the clay in hundreds of places and always found it to contain Bacillariaceæ, the same essentially in all cases.

I gather from this that the clay was formed from the granite and other rocks in the North and North West. The clay is common in large quantities thicker at some places where it settled to form kettle holes which were first known as fossil Diatomaceous deposits. They are common in New Jersey, New York, Connecticut, Rhode Island, New Hampshire and New Brunswick and such deposits as Wecquahick Lake in New Jersey, and Bowkerville in New Hampshire are called kettle holes.

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CHARLES W. SMILEY, A. M., EDITOR.

Remember the A.M.S. meeting at Ithaca Aug. 21, 22, 23.

EDITORIAL.

Professor Lighton's Slides.—From further information we are able to speak more decidedly than last month regarding the stained diatoms. We have got hold of a slide that Mr. Lighton sold for fifty cents and have received a slide from him that presumably represents his best work.

Even in the latter case his slide has had one end broken off in the mails because of slovenly methods of transmission. He does not pack his slides in boxes or slide-holders, but having whittled two pieces of wood to a size one-fifth larger than a slide, he puts the slides between these with layers of blotting paper between them. Then with no protection on the sides or ends he wraps in paper and gives to the mails. It is absolutely indefensible to resort to such methods in order to save the two or three cents which suitable packing would cost.

As to price. Lighton charged fifty cents for these slides. A few years ago that would have been permissible, but today the price as compared with other slides is exhorbitant. The slides of Sinel and Hornell, and those of Watson and Son which sell for fifty cents are greatly superior to Lighton's. Twenty cents each would be enough to ask for the latter.

In response to our request to be furnished with the identical

slide that a subscriber indignantly returned, Prof. Lighton sends it and says: "The mounting medium was not hard when sent and the cover-glass was pushed from place and by some means a little fiber of wool is under the cover-glass. This must have happened when the slide was broken in the mail bag." Surely, Prof. Lighton must have learned before sending to us this last package that his method of packing was bad and responsible for much harm. And still he does not abandon it!

The slide certainly contains some stained diatoms and an enormous amount of foreign matter. No wonder the subscriber caricatured it as "stained dirt." He had a right to expect for fifty cents something very different from what he received. Added to these facts, he complains that when he wrote to Lighton complaining, the latter was exceedingly dillatory in answering.

Prof. Lighton says that he had no trouble in selling out the whole lot, another proof of the patience and good nature of Americans, since only one subscriber has written to make complaint. The money could have been spent far more profitably in our opinion.

Tuberculosis transmitted.—On May 8, 1895, Dr. James M. Byron, a well-known bacteriologist, died in the N. Y. City Hospital of tubercular consumption. More than a year ago, he contracted the disease in the Loomis Laboratory while examining the tuberculous sputum of patients. He was a skilled microscopist and made many examinations during the cholera scare of 1891, as well as of suspected cases of tuberculosis. The bacilli are harmless when examined wet but when dry many float in the air and get into the lungs. He admitted months ago that he had carelessly infected himself by allowing the dry particles to get into his system. He discovered by his own examinations of his sputum that he had the disease and did not at once drop all work and hurry to high, dry latitudes which are known to be favorable to recovery. He sacrificed himself at the post of duty at the early age of 34, having been born in Peru, July 24, 1861.

QUESTIONS ANSWERED.

NOTE.—*Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of all grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.*

225. *Is there any apparatus for making enlarged photos of minute insects? How could a house fly be photographed to ten times its natural size?—F. L. H.*

Any microphotographic outfit will produce photos of insects or any other micro object. A sufficient light and a proper extension of the camera body will give any size of picture desired. A one inch objective at 12½ inches distance from the ground glass, or a two inch objective at 25 inches, will magnify an object 10 diameters.

226. *How can I best get micro-photographic apparatus to fit on a tube vertically so as to photo objects mounted temporarily such as the desmids, diatoms and eggs of insects?—F. L. H.*

Arrange a small platform with a central hole for the microscope tube to pass easily through, and fitted with legs, like a stool. Place the camera, front down, on this support, fasten the camera to the platform with screws; or if preferable, nail strips of wood to keep the camera central and allow easy removal. When the microscope and object are ready, place the platform and camera over it and focus the object on the ground glass as usual. Objects in fluid will require extreme steadiness of apparatus and a cloth-screen around the lamp, so that exposure can be made without causing vibrations in the object or camera.

227. *Do you hold to the good opinion of Friedlander's Microscopical Technology by Howell, expressed in The Microscope of January, 1887?—M. D. J.*

Dr. Stowell was the editor at that time and expressed the opinion. We are not acquainted with the book. Doubtless the advances in knowledge since 1887 have rendered it somewhat obsolete.

228. *Where can I obtain a catalogue of Microscopes manufactured by Siebert?—W. G. T.*

Cannot say. Can any subscriber give the information?

PRACTICAL SUGGESTIONS.

By L. A. WILLSON,
CLEVELAND, OHIO.

How to Examine Mosses.—To properly analyze mosses, an American Bryologist should pos-ess "Mosses of North America" by Lesquereux and James and the "Artificial Keys to the Genera and Species of Mosses" by Charles Barnes. There are many other valuable books on the subject, but these two books will furnish a satisfactory foundation for a start. Without a compound microscope the work is impracticable. For study only ripe and mature mosses should be selected. The first thing that will command the attention of the microscopist will be the capsule. Cut this off close, soak it in water, remove it to a slide, gently remove the calyptra, cut the capsule just below the tip and examine the teeth, cilia, and annulus. These are all beautiful objects. Remember that mosses are very delicate and that rough handling will often destroy the part desired to be seen. If the calyptra be refractory and refuse to come off, boil the capsule for a few moments on a slide in a drop of water. Then the leaves are worthy of attention; are they smooth or papillose? Are the alar cells different from the rest? Is the margin entire or otherwise? Is the point acute, murcronate, or accuminate or what is its form? Is the leaf costate or ecostate? There are many other interesting points to be noted that require a special work upon the subject to treat them properly. The best mounting medium for mosses is glycerine or glycerine gelly but it is better still to keep them in boxes and examine them in water under the 'scope when occasion may require.

A Convenient Receptacle for Diatoms and Butterfly Scales.—Any one, desiring to keep diatoms or butterfly scales for mounting and arranging in forms, can make a convenient receptacle as follow:—Fix an inch or three-eighths inch brass ring to a glass slide; inside of this ring make several inscribed asphalt rings. Use these inscribed rings as the receptacles and

keep each kind of diatom and scale in a separate asphalt ring. The best means of placing the objects in these rings and removing them therefrom is a mechanical finger; but it may be done with a bristle, cat's whisker or a fine spun piece of glass mounted in a crochet needle holder. The latter work will be facilitated with a dissecting microscope, but with time, patience and perseverance, it may be accomplished with a hand lens. Before attempting to pick up, spread the objects on a glass slip and let them dry before attempting any manipulation.

Æcidiacei or Cluster Cups.—This is the season for seeing these beautiful objects. No amateur microscopist who has not beheld them should fail to exhibit a few specimens under his microscope. They burst forth in the spring always on living leaves. The host plants where they may be found are legion. Among other hosts may be mentioned pear leaves, Juniper leaves Scotch Fir, Silver Fir, the wood Anemone, violet leaves, leaves of Goat's beard, Berberry, honeysuckle leaves, nettles, mints, garlic, &c. No more beautiful objects for the microscope can be obtained.

Striated Muscular Fibres.—These can be nicely seen with an inch lens in the muscle of almost any insect. Dissect the insect under water and remove some of the tissue to a slide and examine. The striations will resolve beautifully. For permanent mounting, place the fibres in glycerine. In Klein's standard work on histology the striped muscular fibres of the water beetle (Hydrophilus) are employed as a typical specimen to illustrate human histology. A small particle of meat picked from the teeth, after dinner and placed upon a slide will often beautifully exhibit striped muscular fibre.

SCIENCE-GOSSIP.

Structure and Animal Origin of marble.—Sections of marble and other minerals may be prepared by grinding one side of a slide, to which the object, which has been ground and polished on one side, may then be cemented with hardened balsam. The grinding is done on a plate of glass by the use of emery of different degrees of fineness. The specimen is then

ground down to the proper degree of thinness and need not be removed from the slide.

A true marble is a crystalline rock, rendered so by the action of heat, moisture and pressure, which has changed its texture from that of a common sedimentary limestone to that of a crystalline rock in which all traces of animal life have been completely obliterated.

Of the sedimentary limestones there seem to be two kinds, one having the fossil remains well preserved and another in which no signs of life can be discovered. In this case it is not to be inferred that the limestone was not of animal origin. There are good reasons for believing that the minute forms of life which would, under other conditions, have made up the rock in a well preserved state, have been dissolved out or disintegrated by water highly charged with carbonic acid. This is especially true of the calcareous shells of foraminiferæ, which minute animals live in a stratum of water near the surface, and, as they die, fall in showers to the bottom, to form, under favorable conditions, beds of chalk or limestone full of well-preserved delicate shells.

But if the water through which they fall is deep, and under pressure of that depth highly charged with carbonic acid, they would be dissolved before reaching the bottom; or having reached the bottom, they may in process of time become completely disintegrated, losing their characteristic forms. Prof. W. C. Williamson has given an example confirming this view. In a slab of marble containing a large nautaloid shell there were, in the innermost chamber, foraminiferæ preserved in the most exquisite perfection, while outside of the shell, where the ooze must have been identical with that in the inside, there was a more or less complete disintegration of the foraminiferous shells. Those in the thick nautiloid shell had been protected by it.

Again, of the limestones having the fossils more or less perfectly preserved, there are two kinds; one with the interspaces filled with finely comminuted particles of other fossils, and the other with them filled not with a mud-like matter, but with clear, glass-like calcareous spar. This was doubtless deposited from water holding calcareous matter in solution, but whose solvent power was diminishing, perhaps by passing from greater

to less pressure or by condensation in a sea growing more and more shallow, and being thus compelled to give up more and more of its calcareous matter.—JOHN BOLTON *in P. M. Club.*

Cephalopods as Food.—Several kinds are thus used abroad At Naples they are sold ready cooked, and they are found in the markets of Smyrna and India. In Japan squids are regularly collected for food. In China they form a common side dish, and are eaten fresh, boiled or pickled; in the latter condition resembling the edible birds' nest in substance, color and taste. In Madrid they are eaten broiled or stewed in red wine in a jar. On the coast of France the Loligo sagitta is eaten and said to be "exquisitely fine and delicate."—*S. G. Shanks.*

CORRESPONDENCE.

I am much pleased with your publication "THE MICROSCOPE" and wish I had more time to spare for study. I have one of Beck's binocular microscopes which with accessories cost $1200, including objectives 3 inch up to 1-10 inch immersion.—T. H. H., (Cal.)

The slides ordered through you of Mr. Hornell have arrived safely and I am very much pleased with them.—O. E. S., (Wash.)

RECENT PUBLICATIONS.

Le Naturaliste Canadien.—We can conceive no better way to benefit and interest young people who know just a little french and a little natural science, than to give them a monthly magazine published in the French language and treating topics in science. *Le Naturaliste Canadien* is a 16 paged monthly, size of THE MICROSCOPE at $1 00 per year by M. l'Abbe' V. A. Huard, who lives in a locality far north of Quebec on a tributary of the St. Lawrence. A railroad reaches Chicoutimi, but a train runs up there only twice per week! and yet, this is said to be the only scientific periodical of its kind in Canada.

Any of our subscribers may send us 15 cents for a sample copy or $1.00 for a year's subscription and we will forward it to to our French collaborator.

THE MICROSCOPE.

Contents for June, 1895.

THE MICROSCOPICAL JOURNAL.

Contents for May, 1895.

THE MICROSCOPE.

JULY, 1895.

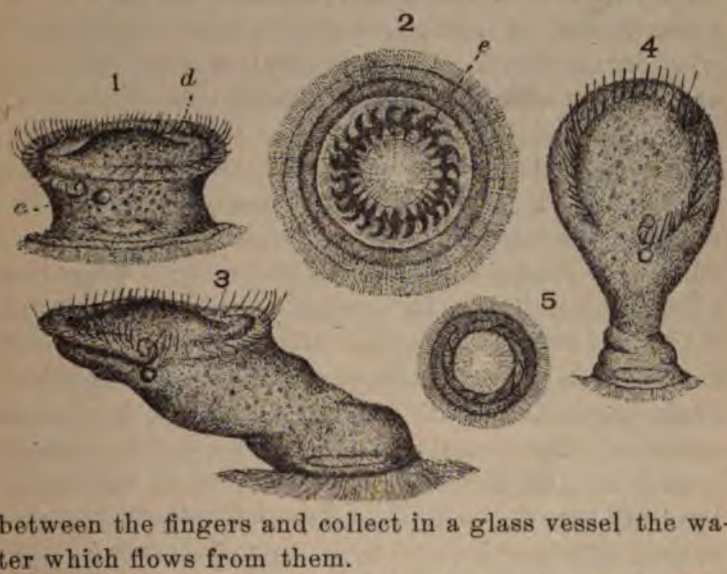
NUMBER 31. NEW SERIES.

The Trichodine Infusoria, a Parasite of the Fresh-Water Hydra.

[Translated from "Le Naturaliste."]

BY CHRYSANTHEMUM.

The fresh water hydra, the most simple of all polyps, lives in all ditches wherever running water bathes the lemna and other aquatic plants. To obtain them, it is sufficient to take a handful of the plants, press them



between the fingers and collect in a glass vessel the water which flows from them.

The next day, one will be almost sure to see against the transparent sides of the receiving glass some little green and brown thread-like bodies, terminated by a bundle of fine grasping filaments. These are the hydra.

The hydra is always accompanied by a parasite, or rather an habitual guest belonging to the class of ciliated infusoria, and which, on account of the singularity of its way of walking, has received the name of Trichodine Louse.

It is easy to observe and study it by taking one of the polyps, placing it in a drop of water upon a glass slide and submitting it to a magnifying power of about 250 times. One then sees moving about upon the whole surface of its body and arms some little animalcule whose general form reminds one very much of a quoit or disc. These discs seem at first sight to touch each other slightly on the surface of their host, to slide lightly against him without touching him, and one asks himself by what mysterious phenomenon—by means of what organs—do they keep themselves erect and move about with so much facility. A closer examination will show.

The Trichodine presents, as we have said, the form of a quoit, or one of the surfaces of a quoit (fig. 1). That one which is turned toward the covering of the hydra is admirably formed for adhesion, the other is adapted to obtaining nutrition. In looking at the upper surface, while in a state of extension and immovability, this infusoria presents to us a circle of hairs analogous to those of the vorticella, but of which the direction is just the opposite. This is rather a hairy tube (fig. 1) which is used to conduct the food to a cavity upon one side of the body (fig. 1, c). At the bottom of this cavity is the mouth. The portion comprised in the circle, and which constitutes the upper disc of the quoit, may, according to the movements of the animalcule, either take a concave form or, on the contrary, enlarge itself into the form of a dome.

If now we pass to the study of the lower or adhesive

surface, we find (fig. 2), surrounding the edge of the disc, a crown of cillia, thickly implanted, constituting a movable collar, the motions and undulations of which permit the organism to move itself by turning rapidly upon its axis. But these hairs present still another property. Strongly adherent to each other, somewhat in the same way as the barbs of a feather, they act as a circular membrane susceptible of attaching itself to surfaces and of holding itself firmly there. This action is still more easily accomplished because at the very base of the fresh water hydra is a true collar, which much assists them.

The Trichodine, when it wishes to attach itself, applies its membrane and ciliated collar to the surface of the hydra. Then, hollowing the under surface of its disc by voluntary contraction, it transforms itself into a true cup-glass, comparable to those well-known adhesive candlesticks which one can stick against a glass, or to the proboscis of the octopus.

But the central part of the contractile disc of the Trichodine does not consist of a simple protoplasmic membrane. We find there a true organism, surprisingly well made for a being so low in the scale of animal life.

Let us press lightly upon the cover-glass of our preparation, in such a manner as to detach some few of the parasites, and let us choose from them one which presents the under surface.

We find then that this surface is formed of a cup very finely striated, and that its concavity increases or diminishes according to the contraction of the body.

In the thickness of the wall of this cup, is a toothed wheel (fig. 2, *e*) of the greatest delicacy, which sends from the side toward the center some fine radial prolongations. From the side toward the circumference it

presents some teeth imbricated with geometric regularity. The toothed wheel of the Trichodines surpasses in regularity and fineness the most precise work of watchmaking. It acts as an organ of support, and possesses, with the striated cup, the property of giving to the body of this being the rigidity of which it has need. The Trichodine, like all ciliated infusoria, multiplies itself by direct division. Its entire body separates itself in two equal parts, which form two new individuals similarly constituted. In this process, the ciliated membrane, the striated cup and the toothed wheel undergo a common destiny; they separate themselves and divide themselves, showing by this that, in spite of their apparent rigidity, they are formed of a still living protoplasm and not of a substance secreted by the hydra.

Such, in a few words, are the characteristics of the parasite of the fresh water hydra. The Trichodines, discovered and described by Trembly as the louse of the hydra in 1744, can be taken as a type of a numerous family of ciliated infusoria, the Urecolaires (fig. 3), whose common characteristic is an adhesive organ, more or less complicated and analagous to the one we have been studying.

In some of these species (figs. 3-5) the toothed wheel is replaced by a simple ring of support; in others a membrane complementary to the collar takes the place of the long, stiff hairs which stand up around the body, but all live as parasites upon the surface or on the internal organs of aquatic animals of either fresh or salt water. Fig. 4 shows Liemophora, a parasite of Ophiura squammata. Fig. 5 represents the interior of its adhesive disc.

The meeting of the American Microscopical Society at Ithaca August 21, 22, 23 will exceed all others in interest. Be sure to go.

How the Change in Color in Petals Takes Place. Keeping Notes. The Brownian Movement.

By ARTHUR M. EDWARDS, M. D.
NEWARK, N. J.

I have been looking over the memoranda of microscopic observations I keep and have kept for over thirty years and find amongst them things that will bear reproduction now and here. And here, by the way, I wish to recommend the keeping of such a book by everyone who observes nature. It is good to put down everything that you see. Never mind how insignificant the facts seem at the time they are recorded thev may start a train of thought then or in the future that may bear fruit that will ripen into a luscious apple or pear of promise. After years I have found that a recorded fact is valuable and can hitch on to a train that will bear me along to a station I have been aiming at for a long time. The notes can be illustrated, never mind if you cannot draw, an illustration will convey the idea that you want better than a whole page of letter press. Colored illustrations are necessary many times and I color them at the time. Another color may supervene and another colored illustration will be necessary. Never mind how much labor it requires. It will tell.

I was reminded of that when I was looking over some notes of mine made in May 1867. They were on the examination of the petals of *Weigelia rosea* the beautiful colored china flower that we have so common in our gardens. The petals are some of them rose colored and some of them white or nearly so. And I wondered why the petals were rose colored when they open and always change to a lighter tint before they fade. I split a petal in two and put it in water on the stage of my microscope and viewed it by means of a ¼ inch objective and a 1 inch

ocular giving me a magnification of 400 diameters.

The petal was pink outside and white inside and the microscope revealed the fact that the white cells were inhabited by a transparent colorless liquid without anything to mark it. But the pink cells had swimming in the colorless liquid what I called then "oil globules" which were colored some darker and some lighter pink. These larger "oil globules" are in number one, two or three and are perfectly quiet, or move about with a slow motion like that of granules which appear when ripe pollen is wet with water. That is to say it is what is known as Brownian motion, and to understand what is Brownian motiou we can imagine a mass of semi-solid white of egg is dropped into water. Now it does not rest quiet but moves about sometimes this way and sometimes that without any means or paddles. And this it does for weeks or years at a time.

This is Brownian motion and was so called because it was first described by the celebrated Robert Brown in a paper published iu 1827. It is now known as *pedesis*, and can be seen even in the contents of fluids in the oldest rocks. The contents of the particles in these have been going on most likely for æons. When I lectured on chemistry in the New York Medical College for women about thirty years ago I was in the habit of explaining Brownian motion by likening it to a globule of Sodium dropped on water which seems alive and moves about in a lively manner. The motion here is chemical and it is likely that all motion is accompanied by chemical action. But, however that may be, the motion of the pink particles in the cells of *Weigelia rosea* is also Brownian. Congregating around these larger "oil globules" there are numerous smaller globules, pink in color and more vigorously in motion. In time the large globules become larger by gradual coalescence of the smaller and in time

they all disappear and the larger globules become transparent and colorless. In this way the petal becomes transparent. Can this be the way that colored petals become transparent and can this be the chemical change that the cell contents undergo? It set me to thinking that perhaps it was. At any rate the observation is interesting and suggestive. These "oil globules" are the same, that is to say have the same general character as the "oil globules" in Bacillariaceæ (Diatomaceæ) but differently colored, and with them are also smaller active granules. The former are the representatives of ova or female granules and the later are the anthozoa or male granules. Can reproduction take place in the cells of *Weigelia* also? It will bear thought.

PROCEEDINGS OF THE A. M. S.—Just as we go to press (June 18), we have received Part II. of the Proceedings for 1894–95. It is labeled "January" and "issued quarterly." It is now just three months since the number for October, 1894, was issued (March 18). The October number was five months behind time and so is the January number. The delay can hardly be due to the wealth of material involved, since not a dozen articles have been printed in both numbers.

The present number contains: The Structure of the Fruit in the Order Ranunculaceæ, by Wiegand; Limitation of Tuberculosis, by Alleger; A Marker, by Prof. Gage; Laboratory Methods, by Krauss; New Section Instrument, by Bastin; and new Cover Slip Forceps, by Gaylord.

The substance of nearly all of these papers has long ago been published by us. One of them, that by Dr. Alleger, on Tuberculosis, was printed in full in the *Journal* and in several Brooklyn papers last year.

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CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

Viewing the Astral Body.—In a book by J. C. Street of Boston, called "The Hidden Way Across the Threshold" is given the following account.

Believing that there was within and about the natural body another body of etherial character, he concluded "that a simple microscopic device could be made that would assist the eye so that it might penetrate the most minute particles of the air we breathe, and thus witness the Soul and this etherial form take flight to the boundaries of the other world."

"Procuring the most powerful lenses I could find, I completed an invention of my own and, when my light was so perfectly arranged that I could examine the microbes in the air, I called a patient who had lost an arm and asked him to put his imaginary hand where I directed. The moment I adjusted the glass, a new world and light of revelation broke upon me. *The real hand lay beneath my glass!* I asked him to make letters with his imaginary finger. He did so, and, to his wonder and astonishment, I spelled out the sentences he thus wrote. This was to me conclusive evidence of an etherial second self."

Perhaps some of our readers can tell us how to examine "the microbes in the air." We have thus far been obliged to catch them and confine them under a cover-glass in order to see them.

Again, we ask how can it be arranged unper so high a power to get a human hand into the field of vision. It is ordinarily supposed among microscopists that not over the size of a needle head can be observed at once under the highest powers. To see a finger is practically as impossible as to see a hand. Unless the words were written too small for unaided human vision, they could not be brought within the field of vision at one time. But to write so finely with a finger or even a pen is an impossibility.

"The second," he says, "was one of great difficulty." Having heard that the astral body leaves and the soul departs at the moment of dissolution he watched for an opportunity to observe. "The time finally came where I had proper conditions of light, etc., where a man of more than ordinary spirituality was being called over to the silent majority. When he was about to cease breathing and a sudden tremor passing through his body announced his hour had come, we (two obervers) passed our heads under the black cloth and bent our eyes intently upon the object glass. Particles of dust in the air were magnified several thousand times, and for a time their motion kept a perfect dazzle upon the glass. Then a thin violet column of vapor gathered into a soft cloud apparently formed over and about the body. Particle seemed to seek particle as if by some molecular attraction, until the outline of an object was clearly distinguishable. As it grew stronger, it seemed the vapory form of a man rapidly assuming a more perfect shape, pure and colorless as the most perfect crystal, having changed from the violet tinge. There was at this moment an awful stillness. An indescribable feeling came over us. Words are inadequate to describe our feelings. We bent our eyes intently on the glass until particle after particle came into the shapely form of the man we knew so well.

It lay floating about a foot above the body, apparently moored by a slender cord to the breast of the corpse. The face was the face of the man, but far more peaceful and beautiful in expression ; the eyes were closed and the new form apparently seemed asleep. We wished he might awake, when the cord that held it to the clay house parted, a gentle tremor passed through the beautiful form, every limb of which was of a per-

fect mould; a violet flame was radiating over the heart, a kind look over the gentle face. The form arose to a standing position; cast one sorrowful look at the tenantless clay that lay so still; extending a hand as it were to say, 'Farewell, thou narrow house; I need thee no more.' it gathered its forces into a little sphere and passed out into the sunlight of the everlasting morrow."

If such astounding phenomena had been observed with camera, for the intimation is that a camera was used in the latter experiment, why have not the details of apparatus been described in the scientific periodicals? The author attributes this account to a scientist who had patents—hence to a physician. Why have we not been furnished with particulars from a scientific standpoint? Why has J. C. Street, of Boston, been peculiarly favored with what to the average scientific mind is an impossible scientific arrangement? And why, in a reputable book of 598 pages, published by Lee & Shepard, and claiming to contain truth and wisdom, are we confronted by such incredible stuff? Does Mr. Street know that he discredits this entire volume by giving us what we can but regard as one piece of humbug? If there is a single microscopist or photographer who credits for one moment the possibility of arranging apparatus as described, will he please to so inform us?

We are not intending to call in question the occult phenomena which the operator claims to have witnessed. Let that all pass to be believed or disbelieved by people who feed on belief or disbelief. The only issue we raise is that such account as Mr. Street furnishes of the apparatus is absurd, and not only unknown to scientific men but incredible in the present stage of progress. We need a full and consistent account of the apparatus and the manner of its use. That is all we care for. Given that, we will find out for ourselves what phenomena can be observed with it, and when found out we will exhibit it to others. Then they, as well as we, shall KNOW what we have seen and have no occasion for belief.

The wholesale manner in which the word science is being used by charlatans of every description is amazing. Honest men should beware how they allow themselves to be misled by mere words. When they find that a writer has either intention-

ally or inadvertently fallen into such methods, they should not accept anything he says unless they have independent means of verification.

Commerce-blackmailing.—On February 28, Messrs Watson & Son, who have been doing the colleges of this country a great service by supplying microscopes at much less cost than they could be made in the United States. sent us an electrotype to replace the one now used in this advertisement. The electrotype, which in this country of high prices and idleness would cost about $1.00, cost in London 62 cents. The commerce-blackmailers in New York affixed a duty of $1.73 which we have refused to pay. The matter has been referred to the Secretary of the Treasury. Running behind as he is every day in the finances of the country, he may refuse any rebate. But if Democrat Carlisle permits such outrages as this, pray what might we expect from McKinley, the prince of commerce-blackmailers. As Bob Ingersoll says: "If God commanded the Hebrews to slaughter 50 000 Amelekites, their wives and children, what might we expect the Devil to do under similar circumstances?"

PRACTICAL SUGGESTIONS.

By L. A. WILLSON,

CLEVELAND, OHIO.

Equisetum.—These plants are commonly known as horse tails, or scouring rushes. They are simple leafless stems or stems with whorled branches and are found growing in wet grounds, lake banks, river banks or border of woods. They furnish interesting objects for the microscopist, such as the elaters and spore. These are found in a terminal cone-like spike of the fruitful plant. Gather a quantity of the stems and on arriving home shake them over a paper and preserve the resulting dust by having it wrapped in paper. When it is desired to examine the elaters and snores, place a small quantity of this dust upon a slide and examine it without a cover-glass with an inch objective. While looking through the tube have a friend breath gently upon the slide when the elaters will spring into

life and action and appear under the scope like a lot of brownies.

The next interesting part is the cuticle which is composed largely of silex. Cut off portions of the cuticle, of suitable size for mounting; place them in a test-tube half full of water, add a few drops of nitric acid and boil for a few minutes over a spirit lamp. This will quickly and easily separate the siliceous cuticle which then should be placed between two glass slips, held together by a brass clip and left to dry. When perfectly dry mount in balsam and examine with polariscope, A beautiful slide will result.

Starch.—Starch may easily be obtained by taking the object containing it and reducing it to a pulp, or powder. For potatoes or seeds a nutmeg grater will effect the proper reduction.

Then have at hand a proper receptacle in which to place a funnel covered with a cloth. Place the pulp, or powder upon the cloth and pour water upon it, the starch will settle at the bottom of the recepticle. Before mounting the starch should be thoroughly dry when it may be transferred to balsam and furnish an instructive object for the polariscope.

Thin Sections of Woods.—These may easily be prepared by taking a pine board into which have been bored a series of holes of sufficient size to contain the specimens of which sections are desired. Insert plugs of the woods into the holes thus prepared and make the sections with sharp jointer plane.

Fibres.—Fibres of silk, woolen, cotton, linen and other fabrics should be teased with needles until they exhibit their natural and original cells. Manufactured threads are composed of many fibres woven or twisted together. After teasing, place on a slide, moisten with a drop of water, cover, and examine with a power equal to a quarter inch objective. A little experience will enable one to determine the nature of the fibres at a glance. Fibres of different substances act differently when soaked in a weak solution of sulphuric acid; it is interesting to soak the fibres in the acid and then examine them under the microscope. This soaking will so differentiate different fibres as to remove all difficulty in determining their nature.

SCIENCE-GOSSIP.

Eye of Beetle for Multiple Image.—Have a diffuse side-light (window with sky or lamp with white porcelain shade between flame and mirrow). Use plane mirror and small aperture of diaphragm. Focus on the piece of cornea; then with one hand held about three feet from the mirror toward the light, with fingers spread and in motion and with the other hand on the fine adjustment, slowly draw the objective back from the slide, watching the facets of the cornea until hundreds of tiny hands are seen. After you have learned how to do it, anything may be substituted for the hand. A profile-face against the sky, a house in bright sunlight, etc. They will not be right side up, owing to reversal in forming the images.—*P. M. Club.*

Starch.—This is one of the substances produced by an actively growing plant, and, like the fat tissue in an animal, it is stored up for future use. The grains are spherical when young but growth being not always uniform, the form becomes ovoid, or of some other figure. When packed away closely, as in the small cereals, wheat, oats, rice, etc., the grains become many-angled by mutual pressure. In the potato the starch grain, attached to the starch-forming corpuscle by one margin, absorbes nutrient sap much as a sponge might absorbe nutrient fluid, and the starchy elements are deposited in greater abundance at the attached (or broad) margin, producing an excentric or one-sided growth, the hilum or narrow end being the distant portion.

Starch grains always occur in all stages of development, and consequently vary greatly in size in the same plant.

Starch, chemically and morphologically, is nearly the same as cellulose. It is a carbo-hydrate. Weak alkalies or acids cause it to become soluble. When it is to become re-absorbed for use in the plant economy, it is in most cases converted into sugar or dextrine, by some of the plant ferment, but occasionally it is only partially dissolved, broken down, and may be detected as starch, in the sap, before assimilation.

Starch when heated to about 400° F. changes into soluble dextrine.

Malting is practically the forcing of germination until the root point is protruded about one-third the diameter of the

grain, then raising the heat and checking further growth. The ground malted grain, if kept in water at a temperature of about 154° F. for two weeks, will become converted into dextrine and sugar, and be dissolved out, leaving only the cuticles of the grain. This action is the result of the diastase developed by the germination of the grain.

Wheat contains 64 per cent of starch, corn 65 per cent., rice 76 per cent, and potato 15–29 per cent—*S. G. Shanks.*

CORRESPONDENCE.

Dr. R. H. Ward, Troy, N. Y., writes regarding query No. 228:—

Reed, Siebert, Alserstrasse 19, Vienna, Austria, makes supplies and magnets, but probably no microscopes.

W. & H. Seibert, Wetzlar, Germany, makes microscopes. Catalogues (probably in German) could be obtained from them by mail.

Purifying Alcohol.—In histological work, especially animal one must make use of more or less alcohol,—absolute, ordinary or commercial and wood spirit. I use all three at times and for various purposes, and as a result have quantities of mixed alcohols vitiated or degraded by water, oils, resins, fats and other organic elements met with in this class of work. Now the question is how to recover the alcohol from this otherwise waste product. Lime disposes of some of the water, distillation of water and as a residue the heavier oils and fats but the first is only a partial success, while in addition the distillation process is expensive. Is there any "royal road" any "cross lots" method by which may be made certain the recovery of this necessary but expensive article? The conditions are that the means all be simple, effective, easy of accomplishment, inexpensive; the result, a comparatively pure product.—*X.*

The Superiority of Direct Illumination.—We are informed that the one seventy-fifth inch of Tolles used with the direct light of a common one-cent spermaceti candle gave a good field and brought out details of human blood dry. Condenser used—a B eye-piece in sub-stage. The same, with re-

flective light gave a field with only one-half or one-quarter of the direct illumination. This proves the great loss of life sustained by using concave mirrors. E. CUTTER.

WHITE'S OBJECTS.—We have just received a large consignment of vegetables sections and can supply all the numbers except a very few.

QUESTIONS ANSWERED.

NOTE.—*Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of al. grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.*

229. *In my histological work I use more or less absolute and common alcohol. I have accumulated quantities of weakened alcohol containing fats and other organic elements. Is there any simple and effective method, cheaper than distillation, by which the alcohol can be recovered from this otherwise waste material.* *X.*

There is no method cheaper and better than re-distillation. Analytical chemists and others, who use quantities of alcohol, usually have some form of automatic apparatus which will run for hours without attention. Remington's still is a good one, and is much used by chemists and pharmacists.

NECROLOGY.

George A. Rex, M. D.—Died at Philadelphia Feb. 4, 1895. Dr. Rex, who was a member of the Phila. Academy of Natural Sciences, was the highest authority on the Myxomycetes in the United States. He frequently read papers thereon before the Biological and Microscopical Sections. He named many new species, but often held specimens for years before naming them in order to be sure that the species when erected would stand. All of the lower orders of fungi interested him. Although a prominent microscopist, he was not a member of the American Microscopical Society. Although a subscriber to the periodicals, he rarely contributed to them.

THE MICROSCOPE.

Contents for July, 1895.

THE MICROSCOPICAL JOURNAL.

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THE MICROSCOPE.

AUGUST, 1895.

NUMBER 32. NEW SERIES.

Objects Seen Under the Microscope.

BY CHRYSANTHEMUM.

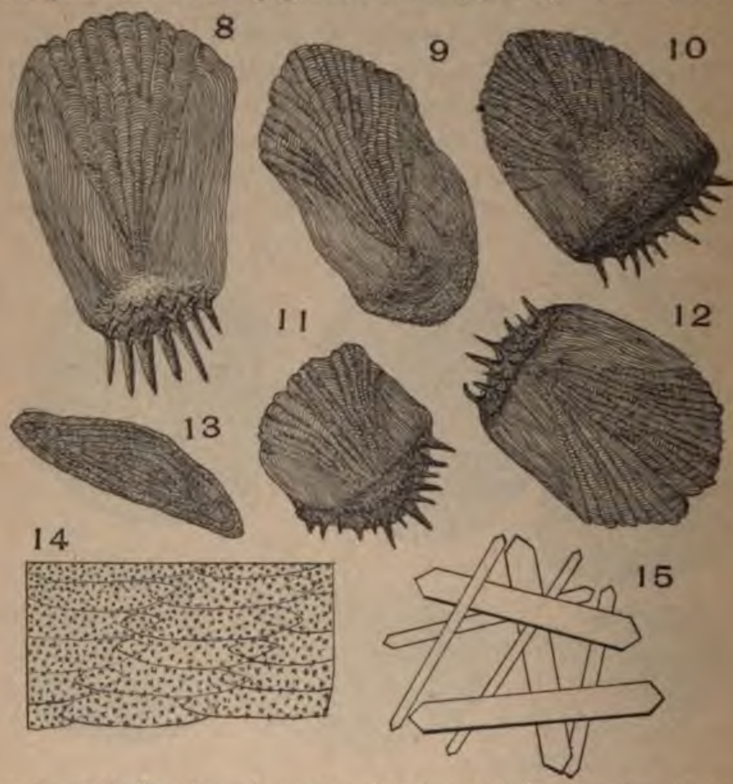
XXV.—SCALES OF FISHES.

The skins of most fishes are strengthened by plates of horny, bony or cartilaginous matter, and when these are so arranged as to overlap one another (fig. 3), somewhat like the feathers on a bird or the slates on a roof, they are called scales. These scales are beautiful and inter-

esting objects when seen with low powers of the microscope.

Some fishes are covered with only a thin layer of skin, in which case the scales can be readily seen; in others they are so deeply imbedded in the skin that we say the fish has no scales, as in the case of the eel.

But the scales are there, and if the under side of the skin be examined after it has been taken from the fish, the scales may be readily seen and removed with a pair of tweezers; fig. 13 represents one of these scales. A piece of the skin of the eel dried and mounted in Canada balsam shows the scales imbedded in the skin, their arrangement and the pigment cells (fig. 14). These, and



indeed the scales of nearly all of our fishes, make beautiful objects for the polariscope. The different scales vary much in color and tone. It is also interesting to view them as opaque objects.

By means of the scales, fishes are divided into four orders, Cycloid, Ctenoid, Placoid, and Ganoid, but most of our common fishes belong to the first two orders.

THE CYCLOID.—The scales are so called because of their roundish form and because much of their surface when magnified is seen to be covered with concentric lines. At the top, where they are attached to the body, these concentric lines are divided by radial lines, sometimes making slight, sometimes deep undulations in the surface of the scale. To this order belong the Salmon, Roach, Gold-fish, Silver-fish, Cod-fish, Minnow, Carp (fig. 2), Herring (fig. 5), Blue-fish (fig. 6), Eel (fig. 3), and others.

Along the side of most fishes is a line known as the lateral line, which is formed by a kind of scale usually more horny than the others and pierced by a tubular orifice having an opening on the upper side near the outer edge and another opening on the under side where it is attached to the body (fig. 7, Salt-water Perch, 5 diam.). In fig. 2, German Carp (2 diam.), this tube divides just above the exposed part, thus having two openings on the under side. It has been supposed that this tube was for the escape of a mucous substance which was poured out from glands beneath, to protect the skin from the mascerating influence of the water and to diminish the friction in swimming, but this has been denied.

By carefully detaching a scale from a bright colored fish of this order, and examining the under side of the part which is exposed, we find a layer of soft substance corresponding in color to the color of the first. Remove a little of this to a slide, and by examining it with a power of 300 diameters, we shall find that it consists of two substances. One is a layer of loose membraneous cells containing coloring matter. These lengthened cylindrical cells are arranged side by side and run at right angles to the lateral line. Now, if a small drop of water be added to this mass and it be gently agitated with the point of a needle, the water around will be seen to be full of minute flat spicules or crystals, varying in size

but constant in form (fig. 15). By transmitted light these are so transparent as to be hardly visible, but with reflected light, or the direct rays of the sun, they sparkle like plates of polished steel. Each of these crystals is constantly vibrating and quivering, and giving one the impression that it is alive although taken from a fish which has been dead some days. This motion is probably due to the vibrations of the water, but it gives that beautiful play of light which we so much admire in the Gold-fish, Silver-fish and others. Notice that in the highly colored fish the exposed part of the scale is more transparent than the other portion (fig. 5).

The Ctenoid.—These scales have the same general structure as the Cycloid except that at the exposed end they are furnished with teeth arranged something like the teeth in a comb. In some scales they are small and set closely together as in the Perch (figs. 4 and 7, 5 diam.), while in others they are larger and much farther apart, as in the Sole (fig. 8, 8 diam.).

In some scales the laminæ show as concentric lines on the outer part of the scale only, the interior being somewhat granular in appearance, as in figs. 4 and 10. The scales on a single fish vary much in size and form, figs. 9, 10, 11 and 12 (8 diam.) coming from the same fish, —one that was sold in the market as a Flounder. Fig. 9 represents a scale from the ventral or white side. Figs. 10, 11 and 12 represent those from the dorsal, and fig. 11 one from near the tail. Fig. 5 (5 diam.) is from near the tail of a Herring. Scales from the central portion of the body of the Herring have somewhat the same outline as shown in fig. 7. It is to be noticed in fig. 8, Sole (8 diam.), that the radial lines look as though they had been split in places and the spaces filled in with a clear transparent substance, but this is not the case. It is claimed that if a thin vertical section of a scale of the carp, which is taken as a representative of

the higher orders, be examined with a high power, it will be found to consist of three layers. The uppermost is composed of several concentric laminæ, the outside one being the smaller, and they increase in size, each being a little larger than the one above it, so that their margins appear on the surface as a series of concentric lines and their surfaces are thrown into furrows and ridges. It is these laminæ which we see, and in some of the furrows the laminæ have entirely separated showing the layer beneath them.

Sometimes in Cycloid scales the pigment cells can be seen giving the scale a spotted appearance, as in the Carp (fig. 2) and Eel (fig. 14).

THE GANOID.—These scales are usually bony, often having the same structure as the bones of the fish to which they belong. They are usually angular in form and arranged in rows, the scales but slightly overlaping one another, thus forming a coat of armor. To this order belong the Sturgeon, Lepidosteus and Hassar-fish, but most of this order are found in the fossil state.

THE PLACOID.—To this order belong the Skate, Dog-fish, Ray and Shark, besides many fossil allies. These are not like the scales we have been examining, but are more like teeth and project from the skin as spines. They are much like teeth in structure and are covered with a hard enamel resembling the enamel of teeth. Fig. 1 represents a piece of the skin of the Thornback Skate, showing spines and pigment cells. It can be mounted dry without a cover-glass and viewed as an opaque object and also with transmitted light, and the polariscope. I know of no objects so easily obtained and mounted which will furnish more entertainment for one's friends than the scales of fishes. Fine mounts of scales can be obtained of Rev. J. D. King, Cottage City, Mass.

Microscopical Characteristics of Oatmeal.

BY M. A. DEROS,
PARIS.

[From *Le Micrographe Preparateur*.]

[In a series of articles on "the Adulteration of Alimentary and Industrial Matters," published in recent numbers of this valuable periodical is a good description of the microscopical characteristics of oatmeal.]

In oats we arrive at corn provided with polyhedral granulated starch. This character renders the mixture of oatmeal with other meals very easy to recognize. These adulterations after all are very rare. As starch forms more than 80 p. c. of the total volume of the meal, it is always relatively easy to find some of the suspected granules in the preparations.

The starch grains of oats are often agglomerated and in small ovoid masses, measuring from 50 to 60 microns in their largest diameter. If these agglomerations are examined with care, the starch grains are distinguished very neatly and closely laid against each other, which gives them a polyhedral form. These granules present pretty clear angles. They are irregular and very small, for their diameter varies from 3 to 9 microns; the average being 5 microns. The hilum is not visible and the concentric layers are scarcely distinguishable. The opening generally happens from the exterior to the interior, but here that character is without importance.

In polarized light on a dark field, the oat starch is scarcely visible. In lighting the field, it is impossible to obtain the black cross of which we have spoken *a propos* of wheat. Treated with potash, oatmeal presents a characteristic appearance. The gluten cells, not so large as those of wheat, are arranged in one row only. The albumenoid matter they contain is in very small grains. These cells do not present a blue coloration after treatment with ether.

The fragments of the envelope of the grain contain two important elements, the hairs and the debris of the glumelle. The hairs are very long, slender and almost deprived of lumen. They are easily distinguished by their form from those of wheat; much more easily from those of rye and barley. The glumelle in oats being always joined to the grain, its debris are infallibly found again in the meal.

They are formed of a layer of cells with thick walls, and deeply toothed like a saw. These indentations work into each other. It is this layer which is characteristic. However, similar cells are to be found in barley-meal, perhaps a little smaller and less toothed, but the confusion between these two meals is not possible, the starches being very different.

Under the layer of toothed cells, which forms epidermis, there is another one composed of long bobbin-like fibres. The debris of the glumelles very much depolarizes the light.

The length of cells with toothed edges varies from 145 microns to 230 microns, the width from 13 microns to 21 microns. The long cells are but slightly visible; the tubes and the transverse cells are not distinguishable. After all, what characterizes oatmeal under the microscope is: first, the form of the grains of its starch, their frequent agglomeration in ovoidal masses and their neutrality toward polarized light; then the form of the long and slender hairs and the presence of cogged cells arising from the epidermis of the glumelles.—R. SAMSON.

The Penetration of Microbes into the Blood.—M. Nocard reported, at a recent meeting of the Society of Biology, Paris (*La Press Medicale*), experiments by which he has been able to demonstrate that microbes are capable of entering the blood through the alimentary canal. (He found that, while the blood is usually sterile after an ordinary meal, after a meal containing a considerable quantity of fat, microbes were found very abundant.) His theory is that microbes are conveyed into blood by the small fat globules which are taken up by the lacteals.

Silvering Mirrors.

By HOMO,
DES MOINES, IOWA.

To the physician, in diagnosing disease, to the dentist at his work and to the microscopist, the mirror is absolutely indispensable. The silvering of the mirrors used often becomes damaged and it would then be a great convenience to the user if he were to possess some simple process whereby he could do the work himself. Many times the microscopist would like to make use of devices that are suggested to him by the work at hand, but is deterred from so doing because of inability to procure material from which to construct them without too much expense. In this work the mirror is often no unimportant part, and to be able to obtain it would be to overcome the greater part of the difficulty. The formulas given below will enable a person so desiring, if he has the suitable glass, to do this class of work easily and perfectly. And if he calls the optician to his aid for the glass, the cost will be found very light. In this article reference is made especially to small mirrors adapted for such use. There seems to be no lack of formulas for doing this work, but most of them have proved in the writer's hands very unsatisfactory and some of no use at all.

The formulas given below have been used for over two years. In recommending them, every attention is given to the details that are necessary in order by their use to do the work. The solutions are simple and easily made and the chemicals such as are usually found in every drug store.

In order to do nice work it is absolutely necessary that the glass to be silvered should be perfectly clean. This being the case, consider first the preparation of the glass. Mirror glass is very soft and there is great danger of scratching. Use no alkalies in cleaning and do

not attempt to scratch the old plate off but drop the mirror into a vessel containing some tameric nitric acid and allow it to remain until the silvering is loose; then rinse the glass thoroughly and clean with prepared chalk, using a clean cloth or Japanese paper. Do not allow the fingers to touch the side which is to be silvered after cleaning and do not use the breath in cleaning. Then cover the glass with alcohol and allow it to stand until ready to plate. When the solutions are ready, remove the glass from the alcohol, place it in a suitable sized dish of porcelain or glass, with the side that is to be silvered uppermost. Then mix equal parts of No. 1 and No. 2, and pour gently over the glass until it is covered. Allow it to remain in this solution for an hour; then pour off the solution and remove the glass, being careful not to touch the plated surface; rinse thoroughly with water and dip quickly into a mixture of solution No. 3 1 part; and water 16 parts.

Remove quickly and rinse thoroughly by dipping it in water repeatedly. All parts of the glass will be covered with the silver, but the face can be easily cleaned by means of a soft cloth; after this is done, examine the plate, and, if it is perfect, cover the silvering with a coating of asphaltum varnish by pouring a little on same and then flowing it over the surface in the same manner that photograph negatives are varnished. When dry, the glass can be cleaned thoroughly and the mirror is done. With care in cleaning the glass and preparing solutions, failure is impossible. The solutions used and mentioned above are made as follows:

SOLUTION NO. 1.

Cryst. nitrate silver,	200 grains.
Distilled water,	6 oz.
Aqua ammonia,	q. s.

Place the silver in a pint (clean) bottle, add water and dissolve. Then add ammonia gradually until the brown

precipitate at first thrown down is just dissolved, no more. Be very careful in adding ammonia so as not to add too much; but in order to guard against an excess of ammonia, add a crystal of nitrate of silver and shake; if the solution becomes turbid it is all right; but if it clears up, more silver should be added until it remains permanently turbid. Then filter solution through a double paper filter, pouring back until it comes through clear; add distilled water through filter to make 12 oz.; place in clean bottle and add 1 oz. alcohol. Shake thoroughly and cork, place in cool dark place for 5 or 6 hours.

SOLUTION No. 2.

Nitrate silver, - - - - -	16 grains.
Rochelle salts, - - - - - -	12 grains.
Distilled water, - - - -	12 oz.
Alcohol, - - - - -	1 oz.

Place the salts and 8 oz. water in a clean porcelain or porcelain lined evaporating dish, place over heat and raise to gentle boil. When boiling add the silver previously dissolved in 1 oz. distilled water and stir with clean glass rod. Continue to boil gently until solution, which usually turns brown then black, turns gray; then continue to boil for a minute or two more; add balance of water and filter through paper; make up to 12 ounces with distilled water and add alcohol. Place in clean bottle, cork tightly and keep for five or six hours in cool dark place.

SOLUTION No. 3.

Cyanide mercury, -	16 grains.
Cyanide potash, ...	8 grains.
Water, ...	2 oz.
Mix. Fiat sol., ...	

This solution is used only for amalgamating purposes and is very poisonous. It has no part in silvering but by displacing a certain portion of the silver with mercury forms an amalgam that is lighter and more adherent to glass then the silver itself. This it does instantly

and if not quickly dipped and as quickly rinsed may ruin the plate. With ordinary care there is no danger of this. When the glass is removed from alcohol to plate do not dry it or allow to become dry, but cover immediately with the wax solutions. Do not allow the solutions to stand after mixing but use immediately.

While the solutions recommended will work equally as satisfactory on larger glass, the process of applying them must be modified.

Do Flies Have Teeth?

BY THOS. J. BRAY,
WARREN, OHIO.

If any one had asked me this question two weeks ago, I should have replied, "I believe not." Last week, being in Minneapolis, I spent all my spare time in the company of Messrs. H. G. Carter and John Walker, two enthusiastic amatuer microscopists. There I saw several new contrivances pertaining to microscopic technique that interested me very much. Mr. Carter has a clever way of making indestructible cell rings, also a very fine transparent amber cement, which is elastic, hence very suitable for ringing mounts. He has recently devised a novel way of preparing the tongues of flies for mounting and an ingenious little instrument by which they are manipulated in the preparation. Mr. Walker has devised an animalcule trap or catcher, which is very simple and effective and can be carried in the coat pocket.

These gentlemen have been giving special study to the mouth parts of flies and they exhibited several slides of this kind which showed very plainly the teeth, of which there are three rows, the back row being the longer and the front row the shorter. Each tooth is "serrated" or notched out on the point with a V shaped notch.

To see the teeth, take a clear mount ot the tongue of a

blowfly and examine carefully at the base of the spiral tubes, and between them will be found the teeth; focus on the front one, then on the middle one, and lastly on the back or lower one. This will give a good idea of the several rows, as well as the individual teeth. In conclusion I will now say, in answer to the query: Do flies have teeth?—"Yes, I think they have."

Disinfecting with Sulphate of Copper.

By M. H. VINCENT,

ALGIERS.

The best agent for disinfection of excrements and of the contents of cesspools is sulphate of copper, especially if care has been taken to reinforce its activity by means of a quantity of sulphuric acid equal to 10 per cent of the excrements. Under these conditions the following results are obtained:

1. For normal stools, putrefied or not, mixed with urine and at an average temperature of 16°C., disinfection is obtained in twenty-four hours, if a proportion of sulphate of copper equal to 6 grams for 1000 c.c., or 6 kilograms per cubic meter is used.

2. For disinfection of typhoid stools and the destruction of Elberth bacillus, the proportion of sulphate of copper is no more, in the same conditions of temperature, than 5 grams for 1000 c.c., or 5 kilograms by cubic meter of excrements.

3. Three grams, 50 centigrams, only of the same disinfectant are sufficient to neutralize 1000 c.c. of matters containing cholera bacillus.

In the two last cases, disinfection is obtained after a twelve hours' contact of the matter with the antiseptic. —Translated by Rene Samson.

Catalogues of W. & H. Seibert are supplied by Fr. J. Emmerich, Sr., No. 74 Murray St., New York, N. Y. O. E. S.

THE MICROSCOPE.

New Series, 1893.

For Naturalists, Physicians, and Druggists, and Designed to Popularize Microscopy.

Published monthly. Price $1.00 per annum. Subscriptions should end with the year. The old series, consisting of 12 volumes (1881–1892), ended with December, 1892. Sets of the old series cannot be furnished. All correspondence, exchanges, and books for notice should be addressed to the Microscopical Publishing Co., Washington, D. C., U. S. A.

CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

Dr. Thomas Taylor has, since 1871, been at the head of the Division of Microscopy of the Agricultural Department. Gradually divisions engaged in other work have managed to control their own details, have acquired their own microscopical outfits, and left little for Dr. Taylor to do. The money available for his use has diminished, the amount last year being $7,500. Secretary Morton not being forced by political sympathy with Dr. Taylor to further maintain his work has felt free to do what he regarded as for the general good, and says in explanation that during the past year five other divisions have done more microscopical work than this, which is doubtless true. We feel sorry to see Dr. Taylor's work broken up but cannot blame anyone for the occurrence.

This is one of the many indications that microscopy as such is not to survive permanently. The use of the microscope like that of other machines is to become subordinate It is a means and not an end. Likewise microscopical societies will succumb before the biological, medical, and other societies whose members use the instrument as a means to certain ends. Strictly microscopical periodicals will likewise die out. This is why for six years past we have allied the JOURNAL with biology and medicine as being two of the principal fields in which the apparatus may be profitably employed.

[illegible]

[illegible]

Projection and Measurement.—The microscope may be used [illegible] for projecting pictures upon the wall. [illegible]

[illegible]

[illegible]

[illegible] and [illegible] a photographic camera. Any sort of camera will suffice if left tight.

This latter method is described on page 233 of Carpenter and is there said "to make the most accurate measurement of which the microscope is capable."

The same results and the same projection of images may be produced with the camera-lucida.

Mounting Diatoms.—Upon a clean cover-glass, previously placed upon a bronze or iron table, are dropped from a pipette several drops of distilled water. Then from the bottle in which

the diatoms are preserved in spirit, is removed a small quantity of the fluid, with the same pipette. Of this fluid one drop is let fall into the distilled water on the cover-glass. Owing to the alcoholic fluid falling into water, the diatoms are scattered all over the cover glass. The metal table is then gently heated, so that the water evaporates very slowly and without ebullition. The rest of the manipulation is performed in the usual manner.

Adulteration of Flour.—Wheat flour may be examined by adding a little water and then a few drops of a solution of potash (one part of liquor potassæ to three of water). Granules of potato starch are swelled by this means to three or four times their natural size, while those of wheat starch are scarcely affected. Comparisons of different kinds of starch under the microscope would guide in many other investigations.

Seeds.—The markings or reticulations on various kinds of seed render them frequent objects for observation, with the microscope.

Many of them are especially attractive when viewed with a binocular microscope. Adulterations may be detected as well as imperfect seeds in a sample—a subject of much importance to a practical farmer.

QUESTIONS ANSWERED.

Note.—*Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of all grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.*

What procedure is necessary to become a member of the Royal Microscopical Society?—*J. E. H.*

Send your application to Mr. W. H. Brown, Assistant Secretary, Royal Microscopical Society, No. 20 Hanover Square, W, London, England. You must send recommendations on personal acquaintance, from two fellows of the Society. Names of American fellows can mostly be found in the list of members of the American Microscopical Society, marked F. R. M. S., in the Proceedings. Regular dues are £2 2 s., of which foreign fellows (as here) pay three-fourths.

THE MICROSCOPICAL JOURNAL.

Contents for August, 1895.

THE MICROSCOPE.

Contents for August, 1895.

THE MICROSCOPE.

SEPTEMBER, 1895.

NUMBER 33. NEW SERIES.

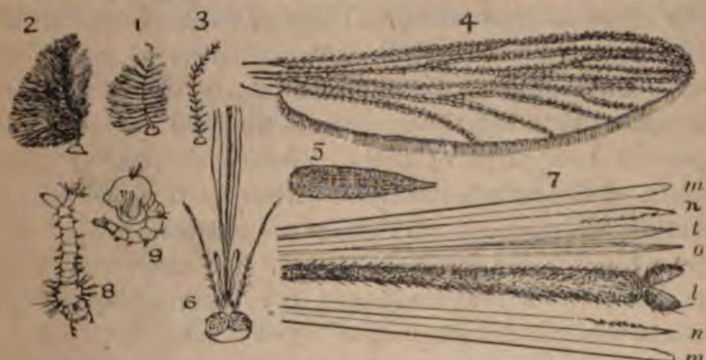
Objects Seen Under the Microscope.

BY CHRYSANTHEMUM.

XXVI.—THE MOSQUITO.

This little insect, which is so troublesome on a summer's evening, is very beautiful when seen under the microscope. It should be studied with both low and high powers, also with reflected and transmitted light.

It belongs to the class Diptera, family Culicidæ. It has a long slender abdomen, narrow wings; a long, slen-



der, but firm labium or proboscis; and, in the male, a plumed antennæ.

There are several insects that resemble the mosquito which belong to the midges; one of these comes in the early spring. It has a beautiful plumed antenna, but it can easily be distinguished from the male mosquito by examining the antennæ. In the true mosquito the antenna has fourteen joints and these joints are surrounded by a whorl of long hairs (fig. 1), while in the midge the

hairs are distributed the whole length of the antennæ (fig. 2). The antenna of the female mosquito is long and clender, having fourteen joints and covered with curved hairs so short that it requires a glass to see them (fig. 3).

The wings are of much interest; notice the arrangement of the veins; it is by this arrangement that many insects are classified. One of the most marked peculiarities of the mosquito is the fringe of hairs around the outer edge of the wing, also the scales along the upper edge of this fringe and on the veins (fig. 4). With a magnification of 150 diameters examine the wing by transmitted light; notice the scales, long and slender, and with a ribbed surface. These ribs extend beyond the surface at the larger end, forming little points (fig. 5).

Let us place the head of a female in a compressorium and examine it. It consists of a hemisphere nearly covered by two compound eyes. These, with reflected light, look like black velvet globes set with rows of gold buttons. On the space between them are placed the two antennæ. Between these projects the labium, and at its base the two palpi of three joints each (fig. 6). The labium of the male is provided with an instrument for extracting the sweets from flowers on which he feeds. He never bites. But with the female it is different. It is she who thirsts for blood and her labium is provided with the surgical instruments for obtaining it.

Now, by a gradual pressure bring the plates of the compressorium closely together and use a high power and transmitted light. We see that the nut-like tip of the labium expands into two concave leaves (fig. 7 b). The outside of these leaves are covered with minute papillæ. This is probably a very sensitive organ of touch. The whole length of the labium is covered with scales and with curved hairs. From a groove along the upper side of the labium should come several filaments (but it is difficult to obtain the desired result on account

of the minuteness and delicacy of the parts). These, we are told, consist of two mandibles, which are narrow blades with a stronger back like a scythe; their tip is brought to a most acute point and the edge in immediate proximity to this is cut into about nine teeth pointing backward; the rest is smooth (fig. 2, n). Next come two maxillæ or lower jaws, having filaments as long as the former but still more delicate, consisting of simple cutting lancets with a back and keen blade (fig. 7, m). Besides these there is the tongue, consisting of a central rod which is distinctly tubular with a thin blade on each side, fine edged and drawn to an acute point (fig. 7, t). There is also the labrum or upper lip. This is an imperfect tube which serves as a sheath for the tongue (fig. 7, o). The labium is about one-sixth of an inch in length. The insect inserts the lancets into the flesh to their full length, the labium being folded back, then through a tube in the tongue it is supposed that a poisonous fluid is injected into the wound to dilute the blood and that the blood is then sucked up through this same tube.

The life history of this insect is interesting. When the female is about to deposit her eggs she selects some floating stick or straw and places her front legs upon it; she then allows the middle pair to rest upon the surface of the water and crosses the hind pair over them to look like the letter X. She then deposits a spindle-shaped egg in an upright position in the angle of the X, and another by the side of it, gluing them together with a cement which is not affected by water. This is continued until a mass much the shape of our life boat is formed. In a few days the larvæ hatch and escape from the lower end into the water. The larvæ (fig. 8) are the well-known "wigglers," having a long segmented abdomen, the next to the last joint of which bears a breathing tube. The insect, when at rest, hangs head

downward with this tube resting on the surface of the water, held in position by many plate-like lobes which are at the end of the tube.

This larvæ grows rapidly, and, after changing its skin several times, comes to the pupa state (fig. 9). The change here is complete. The breathing tubes are now in the thorax and at the extremity of the body is a pair of leaf-like bodies with which it swims. This state lasts only a few days when the pupa skin slits down the back and the mosquito comes forth, stands a few moments on the old skin until its wings are dry; then flies away. The larvæ of the mosquito are beneficial as scavengers, for they feed on decaying matter in water.

Structure of our Hemlock Barks.*

By EDSON S. BASTIN.

Only five species of the genus *Tsuga* are known; two of these belong to Eastern Asia, one, *Tsuga Canadensis*, Carriere, is the common hemlock spruce of the Eastern United States; and the other two, *Tsuga Mertensiana*, Carriere, and *Tsuga Pattoniana*, Brewer and Watson, are natives of the Pacific Coast of North America. All are trees of large size and graceful habit, and the first four are very closely allied, being so similar in appearance that they are with difficulty distinguished, while the fifth, *Tsuga Pattoniana*, is somewhat aberrant in its character, approaching more closely the pines and spruces in its structure.

Tsuga Canadensis is an abundant species in many portions of the Eastern United States and Canada, ranging in its habitat from Nova Scotia to Delaware on the east, extending southward along the Alleghanies to Alabama, and westward along the northern ranges of States and

*For this article and the illustrations we are indebted to the kindness of Mr. H. Trimble, Editor of the American Journal of Pharmacy.

FIG. 1.

FIG. 4.

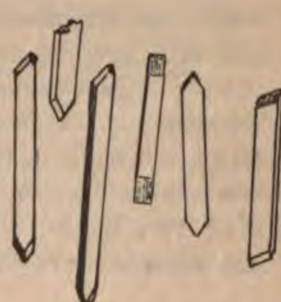


FIG. 3.

the Canadian border to Minnesota. It is easily distinguished from the coniferous trees with which it is associated, by its small cones, one-half or two-thirds of an inch long, pendulous at the ends of the branches; by the slender, spreading branchlets which have crowded apparently two-ranked leaves along their sides; and by the distinctly petiolate, flattened, linear, denticulate leaves, which are green above and glaucous beneath, and provided with a single resin duct on their dorsal surface. Its trunk is extensively employed for lumber and its bark for tanning purposes. Its pitch, also, which is extracted from the old bark by boiling, is employed in medicine for the same purpose as Burgundy pitch. *Tsuga Mertensiana* occurs on the Pacific Coast from the vicinity of San Francisco northward to Alaska. While very similar in appearance to our Eastern species, it is, when fully developed, a tree of much larger size, sometimes attaining a height of 200 feet. It is also straighter-grained, and has a redder and usually thicker bark; but the most distinctive difference, perhaps, is in the fruits and seeds, the scales of the cones being more elongated and the wings of the seeds being relatively longer and straighter. The wood and bark, like those of our Eastern species, are used for lumber and tanning purposes, respectively, but whether or not any commercial use is made of the pitch certainly obtainable from the bark, the writer is not informed.

The barks of these two species are the only ones the writer has examined microscopically. The barks show, as might have been expected, a great similarlty in structure, though there appear to be some characters which we may rely on for distinguishing them. In both, cork formation begins early, and in all cases where the bark has been taken from stems more than a few inches in diameter, the secondary cork-formations have invaded the inner layer of the bark, and bands of cork will be ob-

served crossing at various angles the medullary rays. The cork in both is colored a deep purple, and this coloring matter is bleached out only with difficulty, even by Labarraque's solution. This coloring matter appears to differ in composition from the reddish-brown color-

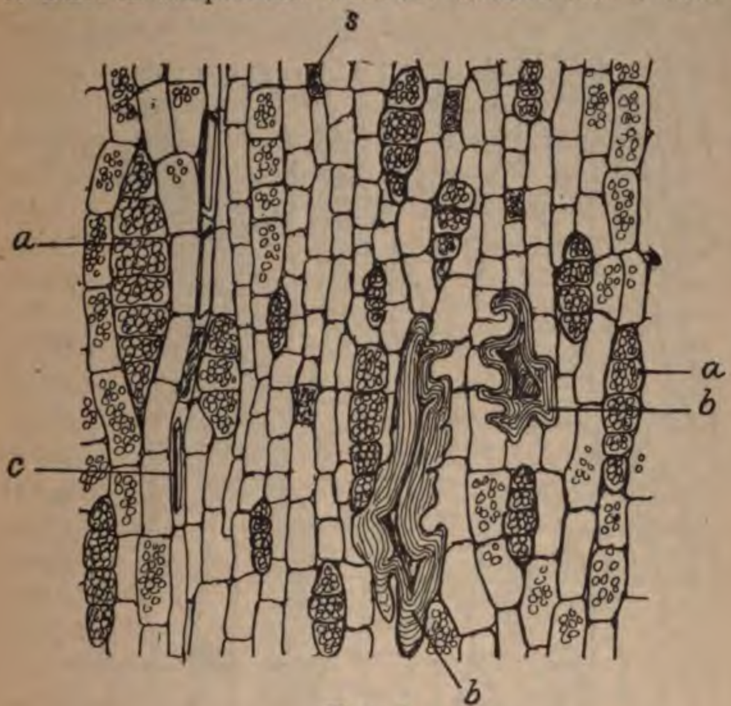


FIG. 2.

ing matter found in the tissues between the bands of cork, for not only is the color a different shade of red, but it bleaches more readily. Tests for tannin show that in both species, also, the white or colorless younger portions of the bark contain little of it, while the older portions, particularly the dead sieve and parenchyma tissues between the bands of secondary cork, are exceedingly rich in it. Stone cells of large size and often quite irregular shape occur, either isolated or clustered in groups of several or many, throughout all except the

youngest portions of the inner bark. They are quite numerous, but are distributed without apparent order. They are marked with numerous very fine pore-canals, and very numerous and fine concentric lines. Abundance of starch was found in the bark of *Tsuga Canadensis*. The medullary ray cells and the tangential rows of large

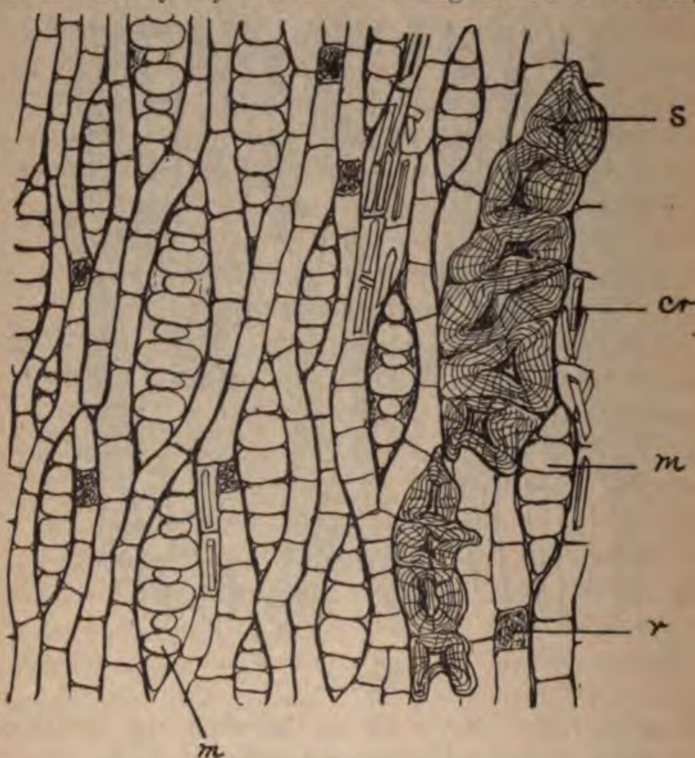


FIG. 5.

parenchyma cells, which occur at frequent and regular intervals in the inner bark, were found to be especially rich in it; but, strange to say, no starch was observable in the bark of *Tsugu Mertensiana*, although there were a similar structure and arrangement of medullary ray-cells and there were the tangential rows of large parenchyma cells, the same as in the other species. The very

close structural resemblance of the barks, and the very intimate relationship of the two species in habit as well as in structure, suggest that the presence of starch in the one and its absence in the other was only a seasonal difference. But this is a point which requires further investigation. The medullary rays in both barks are composed of single rows of cells, and these are radially elongated and of large size as compared with those of adjacent tissues; but those of *Tsuga Mertensiana* are, on the average, larger, and the rays in this species, as seen in a longitudinal-tangential section are composed, on the average, of a larger number of cells. These differences in the medullary rays are perhaps the most constant ones between the two barks.

Both barks contain abundance of crystals of oxalate of calcium. These are mostly in the form of long prisms, and are contained in rows of elongated cells of narrow diameter, which traverse the bark in the direction of its length. The crystals are frequently associated in the containing cells with resinous and coloring matters. In form and arrangement they do not differ in the two barks, but appear to be rather more abundant in the Pacific Coast species.

Oleo-resin cells appear to be about equally abundant in the two species. Those that do not also contain crystals are isolated or in rows of two or three, and the cells are shorter and broader than the crystal cells, though they are not usually so large as the parenchyma cells with which they are associated. They are scattered without apparent order through the inner bark. Besides the oleo-resin cells proper, just described, oleo-resin occurs in many cells not especially devoted to secretions. This is particularly true of the cells in the older portions of the bark.

DESCRIPTION OF FIGURES.

Fig. 1.—Small portion of cross-section of bark of *Tsuga Canadensis*, magnified about 50 diameters. *c*, *c*, *c*, secondary cork formation ; *a*, dead phloem

tissues rich in coloring, resin and tannic matters; *s*, *s*, stone cells; *m*, *m*, medullary rays; *cr*, crystal cell; *ca*, cambium.

Fig. 2.—Small portion of longitudinal-tangential section of the inner bark of *Tsuga Canadensis*, magnified about 75 diameters. *a*, *a*, medullary rays, the cells containing much starch; *b*, *b*, stone cells; *c*, row of cells containing crystals of calcium oxalate; *s*, cell containing oleo-resinous secretion.

Fig. 3.—A few of the crystals magnified 230 diameters.

Fig. 4.—Small portion of cross-section of bark of *Tsuga Mertensiana*, magnified about 50 diameters. *c*, *c*, *c*, bands of secondary cork; *a*, intervening dead tissues composed of sieve and parenchymatous elements, and like the other species, rich in tannic, resinous and coloring matters; *s*, *s*, groups of stone cells; *m*, *m*, relatively large, fusiform medullary-ray cells; *b*, band of large parenchymatous cells; *cr*, crystal cell; *ca*, cambium cells.

Fig. 5.—Small portion of longitudinal-tangential section of bark of *Tsuga Mertensiana*, magnified about 75 diameters. *s*, cluster of stone cells; *cr*, crystals of calcium oxalate; *m*, *m*, medullary rays; *r*, oleo-resin cell.

A Comparison of American and Foreign Microscopes.

By C. H. EVANS, M. D.,

CANTON, OHIO.

I have used the microscope for 25 years, have had American and Foreign, (French, English and German). The cheap French instruments are a delusion and a fraud. The stands made by Bausch and Lomb are very good and so are Zentmayer's. Some years ago I bought a Bullock's Professional but did not like it for high power work. The stage rotation was not as true and steady as I expected to find, and the fine adjustment of all the American stands moves too rapidly for high powers. I saw the advertisement in the MICROSCOPICAL JOURNAL of W. Watson & Sons, London, with a discription of their Van Heurich stand and was satisfied that if it was what was claimed for it, it was the best stand in the market at any price. So I ordered one. It cost me $135 with a 40 per cent duty added. I have been using it about six months and I can say after an extended trial that I find it as near perfection as it is possible to get. It is really a beautiful stand and I believe is cheap at the price. I am a believer in protection to American industries and

home manufacture but yet I believe in getting the best in everything microscopical and I can say that Watson's stand (the Van Heurich pattern) is the finest piece of workmanship both in design and finish that I have ever seen or used and I do not hesitate to recommend it for any one that can pay the price.

I have three stands and often I use all three one after another to save time in changing objectives. My microscopical outfit will invoice over eight hundred dollars net.

PRACTICAL SUGGESTIONS.

By L. A. WILLSON,
CLEVELAND, OHIO.

How to Examine Objects with the Microscope.—Many amateurs defeat their own purposes by attempting to examine too much of a substance at one time. Thin sections and small portions of objects to be examined should be placed under the microscope. The microscope, as the name implies, is an instrument for the examination of small things. Generally a very small particle of the substance to be viewed will answer far better than a large amount. A particle as big as a pin's head is usually sufficient. In examining blood such a quantity is a plenty; but a drop as big as indicated is too large until it is spread out. Place the drop to the left of the center of a glass slip; take another slip with a true edge; with the latter press firmly and draw to the right so that but a thin film is left on the first slip of glass, cover immediately with a thin glass and examine with a fifth or quarter objective and the corpuscles will be nicely displayed. In the case of starch or spicules use but a small drop and examine under a cover and much more will be seen and made more beautiful than if a large or thick mass were attempted to be examined.

So with butter, a drop as above mentioned placed on a slide, covered and pressed with the finger into a film, will under a quarter objective instantly show the natural crystals. The rule here stated is a good one to become accustomed to and exper-

ience will demonstrate that too little will be more satisfactory than too much.

Oscillatoria.—These plants are very beautiful objects for the microscope. They are frequently found free in water. Often they form a thick green scum on the surface of stagnant water and this scum when gathered will form a thick mat. Having a piece of this mat to examine, with the forceps pinch off a piece as big as a pin's head; transfer to a glass slip; cover with a drop of water tease out with needles, cover and examine and a beautiful object will be presented. They are composed of fine microscopic threads containing a blue-green endochrome which is sometimes replaced with red or violet Many genera are enclosed in a hyalene gelatinous sheath. Their motions, whence their name are derived, is interesting.

Needle Holders. There is nothing nicer for dissecting needles that the croch t needle holders which may be procured from any store that deals in fancy goods. Common needles of any suitable size may be inserted and when the needles are broken or useless, new ones may be quickly inserted. These holders are inexpensive and will last a life time, while needles permanently mounted in handles when broken render the entire tool useless.

QUESTIONS ANSWERED.

NOTE.—*Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of all grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.*

230. *What are the best books with which to identify microscopic forms which are found in aquaria and ponds?*

The best books are Kent's Manual of the Infusoria and Hudson's Rotifera or Wheel-Animalcules.

231. *Where can I get information as to the best methods for pressing and mounting plant specimens and the best sort of a show case for exhibiting them?—L. Stevenson.*

Gray's Lessons and Manual of Botany. Encyclopædic Britanniac—article: Herbarium. Botanical Gazette, Vol. XI, No. (June 6, 1886), Herbarium number.

All contain directions for preparing plant specimens. The specimens, mounted on cardboard, are usually kept in tight drawers or on shelves tightly inclosed to keep out dust and insects.

THE MICROSCOPE.

New Series, 1893.

For Naturalists, Physicians, and Druggists, and Designed to Popularize Microscopy.

Published monthly. Price $1.00 per annum. Subscriptions should end with the year. The old series, consisting of 12 volumes (1881–1892), ended with December, 1892. Sets of the old series cannot be furnished. All correspondence, exchanges, and books for notice should be addressed to the Microscopical Publishing Co., Washington, D. C., U. S. A.

CHARLES W. SMILEY, A. M., EDITOR.

RECENT PUBLICATIONS.

Chiero's Language of the Hand. A complete practical work on the sciences of chieromancy and cheirognomy, containing the system, rules and experience of Chiero the Palmist. The Transatlantic Publishing Co., London and New York.

This is an exhaustive and admirably written treatise on the science of Palmistry. It not only contains a complete exposition of this branch of psychological study for the use of the student, but is a valuable work for every thoughtful investigator on the lines of natural physical science. As the author truly says:

> The greatest truth may lie in smallest things,
> The greatest good in what we most despise,
> The greatest light may break from darkest skies,
> The greatest chord from e'en the weakest strings.

Forty full-page plates fully illustrate the subject treated, in addition to over 200 engravings of lines, mounts, marks, etc. Among the former are reproductions of the hands of a number of world-celebrated personages, which make an interesting comparative study, including those of Sarah Bernhardt, Mark Twain, "Bob" Ingersoll, Mrs. Annie Besant, Sir John Lubbock, and many others.

The book is the result of exhaustive study and research on the part of the author in all parts of the world, and is probably the most elaborately written work on the subject yet published.

It carries to the reader the intense earnestness and belief with which the author is evidently inspired.

Systematic Study of the Organic Coloring Matters by Drs. G. Schultz and P. Julius, translated and edited by A. G. Green, F. I. C., F. C. S. London: Macmillan & Co. $5.00.

This is a valuable work primarily intended for the use of those interested in the coal-tar color industry and the users of its products. Here are set forth in detail all the various bodies: hydro-carbons, phenols, bases, etc., contained in coal-tar, together with the intermediate products and coloring matters. Under the latter heading will be found a series of admirably arranged tables containing all the information that can possibly be required for the use of the dyer. The commercial name of the product is set forth together with the scientific name, empirical formula, constitutional formula, method of preparation, year of discovery, discoverer, patents, literature, its behaviour with reagents, shade and dyeing properties and method of employment. To the user of coloring matters and to the chemist the work is of great value.

Paul and Virginia.—Bernardin de Saint-Pierre, translated with a biographical and critical introduction by Melville B. Anderson. A. L. McClurg & Co., 117-121 Wabash Avenue, Chicago, Ill. $1.00.

In this story Saint Pierre uses the beauties of nature as seen in tropical seashore and cliffs as a background for a picture of the moral beauty of a little community. The portrayal of human nature and manners is no whit less faithful and vivid than the unrivalled picture of tropical landscape. The development of the two principal characters from childhood to manhood and womanhood is drawn with a fidelity that makes admiration increase with study. This book is worthy to be included among our classics. It has been translated many times but never with so much accuracy and such beauty of language as by Prof. M. B. Anderson of Stanford University. The book contains, besides the story, a fine biography of Saint Pierre and many critical notes, and is well adapted for use in schools. Prof. Anderson has also translated Hugo's "Shakespeare," "George Sand," "Madam de Sevigne," "Thiers," and others.

SCIENCE-GOSSIP.

Audubon Sugar School.—The fourth annual session of the Audubon Sugar School closed on Saturday, June 29th. Since the opening of the school in October, 1891, over sixty students have matriculated, coming from Cuba, Porto Rico, Spain, U. S. Colombia (South America). St. Croix, Hawaiian Islands, and the States of California, Kansas, Nebraska, Illinois, Tennessee,, Georgia, Mississippi and Louisiana. Over one-half of the above number have been from Louisiana.

This school has been established and is being prosecuted solely with the view of benefitting the sugar industry of Louisiana. It, therefore, appeals to the sugar planters of this state for their earnest sympathy and support.

Upon the grounds are conducted a large number of experiments in sugar cane (covering over 100 in different kinds of fertilizers, 50 or more in physiological tests, 30 plats of varieties of cane, including several promising varieties of seedlings and numerous experiments in different modes of cultivation, drainage and irrigation). Besides sugar cane, numerous experiments will be found in corn, sorghum, teosinte, grasses, clovers, alfalfa, and other forage crops, ramie, jutes and hemp garden and fruit crops.

There are three well equipped laboratories:

1. Agricultural, where special investigations of soils (physically and chemically), fertilizers, feed stuffs, coals, bone-black, etc., are made. Mr. J. L. Beeson, a Ph. D., of Johns Hopkins University, has charge of this laboratory.

2. Organic and Sugar Laboratory, where the physiological and organic properties of the sugar cane and kindred plants are studied, and where sugar chemistry in all of its branches is carefully taught. Mr. L. W. Wilkinson, M. S., a graduate of the University of Heidelberg, directs the work in this laboratory.

3. Station Laboratory, where analyses of all kinds are made for the public good. Mr. R. L. Bivins, M., S., a graduate of the Alabama Polytechnic Institute. has charge of this laboratory.

In the Department of Mechanical Engineering there is, besides a fully-equipped sugar house, a drawing room with every facility for excellent work, furnished with handsome drawings and illustrations of the various sugar machinery made by the leading manufacturers of the world. Mr. R. T. Burwell, M. E., of Cornell University, has charge of this department. Wm. C. Stubbs is director.

THE MICROSCOPE.

Contents for September, 1895.

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THE MICROSCOPE.

OCTOBER, 1895.

NUMBER 34. NEW SERIES.

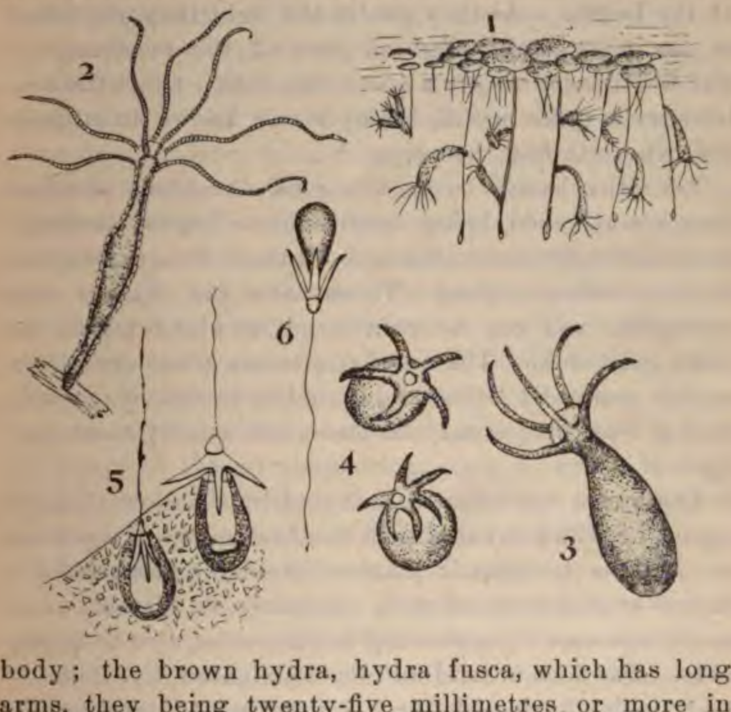
Objects Seen Under the Microscope.

XXVII.—THE FRESH WATER HYDRA.

Translated from "Le Micrographe Preparateur."

BY CHRYSANTHEMUM.

There are three kinds of fresh water hydra in our country; the green, hydra viridis, which has short arms, their greatest length being about one-half that of the



body; the brown hydra, hydra fusca, which has long arms, they being twenty-five millimetres or more in length; and the gray or common hydra, hydra grisea or vulgaris (fig. 1, 2), whose arms vary in length.

To procure this animal, take in a vessel some duck-weed from a ditch or pond of stagnant water. Put this in a receiving glass and cover the glass with a thick paper, leaving a vertical opening on one side. The next day, take off the covering and look at the under side of the weeds. A large number of white roots will be seen extending into the water. Among these the polyps will be found. They are quite in their element here. Their arms and bodies mingle with the filaments of the roots, which, on account of their resemblance, serve as a means of protection. The hydra hold themselves rigid, head-downward, their arms hanging like a woman's hair (fig 1), in such a way as to be easily mistaken for the roots of the Lemna. As they prefer the light they are found in the most highly lighted part of the receiving jar. The floating leaves are also on this side. Our little contrivance is quite useful, for by it one knows in advance just where to find the polyp.

Take the hydra by breaking off the plant to which they are attached, being careful not to destroy the arms, which are sometimes attached by their free extremities to surrounding objects. These arms (fig. 2), are very extensible and can be contracted or elongated in the same individual. The number of arms is not always six, as it is generally believed, but, unless in case of accident, it is at least six; it may be more, but usually some multiple of six.

The hydra has a foot terminated by a hollow disk, by means of which it can attach itself to bodies in the water as well as to aquatic plants. It is found attached to stones or stakes standing in the water, to bits of wood, or strings and ropes floating in the water, also to fishing nets. The foot is solid and is terminated by a hollow body which is shaped like the finger of a glove, having but a single opening. This cavity acts at the same time as a stomach and an intestine. Its opening is at once

the mouth and the anus of the animal. To this orifice the arms or tentacles are attached. These tentacles are used to catch the anamalcules on which it preys. They are straight but flexible and easily assume a spiral form, for they are very retractile. They roll themselves around the Daphnies, the Nias, and a host of other little animals that live in the water either in a perfect or larval state, for there are without doubt thousands of different kinds of animalcules which inhabit little ponds. When the hydra have swallowed their prey, the body dilates and loses its long form (fig. 3), becoming cylindrical or conical (fig. 4), at the same time the arms contract, making them unrecognisable.

The hydra hunt like a blind person. They do not throw out one of their arms, like a serpent, against the animal which passes; but as a spider spins his web so they send in all directions into the water some fine threads or else fix them, in perfect rigidity, to neighboring objects, much like a snare. When an animalcule touches one of these free or fixed threads it is immediately struck with paralysis and remains adhering to the arm which it has touched. The hydra has sufficient time to surround its captive and draw it into its mouth.

This phenomenon, so strange and unexpected, is due to the fact that the fresh-water hydra contains some internal organs which secrete a special poison. These consist of a spiral thread connecting with a sac of poison. Every one has heard of the Galeres, that paralyse the bathers, in tropical waters, by their tentacles by giving them urticaria or nettle-rash of sufficient violence as sometimes to cause death. It is on this account that the sea anemones have received the name of sea nettles from some fishermen. The corals and madreporaria are more or less provided with these poison sacs; some fresh water zoophites also have them.

If the arms of the hydra are examined with a low

power they are seen to be covered with a series of little points. It is these which contain the poison sacs. They consist of a depression containing a bladder full of liquid haline, in which is plunged a spiral thread terminated at the base by an enlarged trident, the hooks of which turn back (fig. 5, 6). At the least touch, the spring unrolls itself and the filamant, impregnated with the poison, penetrates the body of the imprudent beast, which thus loses his power of voluntary movement. The three hooks at the end of the sac cannot penetrate into the body of the victim since they are at the base of the thread and not at its extremity (fig. 5), as has been erroneously stated. Besides, if they penetrated at the same time as the needle the animal would lose them because he would not be able to withdraw them. It is true there would still be enough left, for his tentacles are covered with them.

The hydra have many curious peculiarities. They walk like the Geometrid caterpillar, using their mouth as a cupping glass as opposed to that of the foot. They take a step upon the head and draw up the foot to the neck and so continue. They run as a gymnast, who turns a somersault upon his hands to come back upon his feet again on the other side. They have no eyes yet they seek the light the same as plants and infusoria.

They probably feel light as we feel heat. They digest with their skin as with their digestive mucous. This is proved by turning them inside out as we do the finger of a glove. A hydra which has been turned inside out can be made to swallow an ordinary hydra or vice versa, and two hydra can be joined body to body so as to make only one, armed with a double row of tentacles. They can be made to grow again or can be made to grow from a piece.

I. TO TURN A HYDRA INSIDE OUT. There are several ways of doing this. A practical way is to take advant-

age of the peculiarity which these animals have of dilating themselves when they have swallowed a voluminous prey. Give them a bait like those employed by fishermen. This may be the larvæ of the diptera, Chironomus plumose. The hydra dilates itself to swallow. Profiting by this movement, pierce his body from behind toward the front with a thread of stiff silver or a steel wire such as is sometimes found in a box with syringes and used to clear the injecting needle. The hydra struggles and throws itself up suddenly into its normal condition; but try again with patience and at length he will be fatigued. Hold with a pair of forceps the upturned part and the animal will finally allow himself to be turned. At the end of two days, or even less time, the hydra is hungry and commences to eat in his new position, but still trying to return in part to his former position. At first he digests with the part of the stomach which he has drawn inside, but soon he digests completely by the aid of his skin, this having become a digestive mucous. Sometimes he grows together in the position at first taken and continues the live thus, although somewhat shortened in length. Care should be taken in the first few days to keep him in position by a needle, which prevents him from returning to his normal position by pressing from the interior toward the outside to prevent his drawing himself into himself.

The hydra can make a new mouth if for any reason the old one is destroyed. This happens when the estosarc is held against itself. It forms cicatricial shrinking which finally obliterates the exterior orifice. A new mouth then forms underneath the strangulation. The anterior part may dilate itself either wholly or in part, the result of which is a new mouth, lateral in the latter case, terminal in the former.

II. To UNITE TWO HYDRA INTO ONE. This operation can be performed in two different ways, either by unit-

ing the skin to the skin or the mucous to the mucous. But one cannot unite the skin of one to the mucous of another, for when a small hydra is swallowed by a large one, the larger one soon rejects it, or if it happens that the small one is retained the large one finally digests it. They cannot be made to grow together.

To unite the hydra, mucous to mucous, turn as the finger of a glove the polype which is to be swallowed, and cause it to be taken by the second one by pressing it into the digestive cavity with a silver wire. The two mucous membranes are then in immediate contact. In a few days the walls of their bodies have grown into one, and it is only a single polyp that digests with what was the skin of the smaller animal, the only difference being that its body is thicker than in the normal state, for it is composed of a double row of tissues and that it has a double row of tentacles.

To make them unite skin to skin, the one which is to swallow the other should be turned inside out and by the aid of a needle pressed one inside the other.

When one attempts to unite the skin to the membrane and holds them (the little one swallowed by the larger one) together with a needle inserted transversly; it happens that they do not grow together but the exterior hydra allows himself to be torn by the needle the whole length of his body, while the smaller one remains whole but taking the needle with him. The larger one grows together again.

III. To DIVIDE A HYDRA INTO SEVERAL. When a hydra is divided into two parts lengthwise, in twenty-four hours the parts will have healed leaving two polyps,each a little smaller around than at first and having one-half the number of tentacles of the original. When a hydra is cut in two transversely it takes two days for one part to form a new foot and the other a new crown of tentacles. When a hydra is cut into three pieces with the

scissors in one week there will be three complete hydra. When a hydra is cut in two transversly and longitudinally, at the end of eight days there will be eight hydra. Several pieces of the same animal can be made to grow together and also pieces of several different animals .

It is quite difficult to perform the preceding experiment by uniting the green with the brown hydra.

Reproduction is produced by budding and by eggs. When the animal is well nourished the food produces little hollow buds which communicate with the digestive cavity of the mother. At the end of two days in summer and six weeks in winter this little bud is detached and becomes a separate animal. The hydra does not usually carry more than five buds at the same time, these being in different stages of development. But in artificial culture with a high temperature and plenty of food more are produced and they remain attached to the mother a longer time. Tremblay had a gray hydra which carried nineteen little ones which belonged to three generations.

The fresh water hydra will not form a new individual from a tentacle, although some salt water species can be made to do so. Sexual generation is produced by fecundated eggs. Toward the last of the summer the foot produces some protuberances which at first resemble buds but instead of producing either a mouth or tenlacles they form in their cavity either ovules or spermatozoa. These external organs should be considered as being true individuals charged exclusively with the care of reproduction, as it is often the case with marine polyps.

PERSONAL.

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One of the Questions that Meets the Student of Bacillaraceæ.

BY ARTHUR M. EDWARDS, M. D.
NEWARK, N. J.

The finding of "species," as they were called by the older observers, and the naming of them is not the duty of the true student of the Bacillaraceæ. The naming of them is easy enough; if a name cannot be found that suits their peculiarity, a name of some person or place can be substituted. But when we come to give a name which describes their peculiarities is is more difficult. For instance, it is easy to name a little boat-shaped green cell when it is recent and call it Navicula viridis. But when the boat-shaped cell is twice or three times as large it may be called Navicula, or little boat, which is larger, or major. But this is giving a "specific" name to the object and it has not a right to the "specific" name. For it is a sporangium, as it is called, of Navicula viridis. So with other so-called species. The finding out the why and wherefore of things and of their being is the true duty of every naturalist.

Some time ago the question of whether the Diatomacæ or Bacillaraceæ were single or multiple cells came up in the investigations of Dr. Wallich, and he contributed a paper to *Popular Science Review* on the subject. I do not remember what conclusion he came to, but this is what I came to—the Bacillaraceæ or Diatomacæ are multiple cells. Again I am puzzled to meet the question, for there are certain peculiarities that appear as the magnification, if the Bacillaraceæ is made more clear by modern objectives. Again, I am inclined to the multiple side of the question. And for this reason, Pediastrium granulatum, F. T. K., an extremely common Desmid, was examined in Peckman's Brook, N. J., this May. This is a beautiful form, being like a green star.

Along with it was Melosira crenulata, F. T. K., Bacillarian, also very common. This looks like a number of pill boxes, but with the endochrome, or coloring matter, of a fawn tint. There are other Bacillaraceæ also in abundance, but of those I do not wish to speak at the present time. Closterium is a very common Desmid everywhere. It looks like a brilliant green quarter moon and looks as if it were multicelled, or made up of two cells not separated by cellusose, but the contents of the cells are separate for cyclosis, or the movement of the protoplasm, which takes place in two separate whorls, being transformed from the ends towards the center on the outside of the cell; but inside the cell wall, which is made up of extremely delicate hardening matter, it is cellusose most likely. In Pediastrium the cells are made up of cellusose also, but are separately arranged in the form or a star and they are evidently separate cells. In Melosira the cell walls are siliceous and in a chain. As I have said, the Pediastrium and Melosira are evidently multicellar. In Closterium the contents are in one investing membrane, but the cell contents, or endocrome, is divided into two parts. Navicula is also separately celled, or multicellular, although the contents do not move as in Closterium. For there are several anothozoa or male organs at least, which are circular-celled "oil globules" and in the spring are active, and two large "oil globules" which are ova or female organs. From this reason I believe that the Bacillaraceæ are multicellular.

I have recently studied a Bacillarian which is Cymbella lanceulula C. G. E., which is the same as Cocoonema lanceola to C. G. E., and is the sporangium of a small species, perhaps Cymbella cistula H., which is also present in the same gathering (book on Orange mountain, New Jersey), and I see that the C. lanceolata has the cell contents separated into two portions, and at each end on

the frustule, so that this can be said to be multicellular. Perhaps this is the case with other species when they occur as sporangia, but I have not witnessed it as yet.

Farrant's Medium.

BY THOS. J. BRAY,
WARREN, OHIO.

The mounting medium known as "Farrant's" is a very viscid mixture of gum arabic, glycerine and camphor water. It is an excellent, ready and suitable medium for mounting vegetable sections, etc., but is not as much used as it ought to be by reason of the persistence with which air bubbles are held in the compound. The question is often asked, "How to remove the bubbles?" My answer is, "Don't let them get in." The reply to this is invariably, "Easier said than done." There is no trick in it, provided certain rules are followed. I may not be able to give your readers the *best* method of doing it, but will give my way of operation, which, if followed closely will avoid the troublesome air bells entirely.

PREPARE CELLS. These may be Carter's culluloid, which I use, or made of King's cement, gold size or other suitable material spun on the slide. They must be dry and hard, see that the top surface of the cell is *level* and *smooth*, then take a piece of clean wire and put it end foremost into the bottle containing the medium and let it remain there until ready for use; this wire is used as a dropper. When ready lift out the wire and hold it over the cell about a half an inch above it; a drop of *solid* gum solution will soon form at the end and fall off into the cell. Put the wire back into the bottle, take the specimen and place it on the drop in the cell and allow it to fall to the bottom by its own weight if it will do so, if not, then a very gentle pressure will help it. Avoid stirring the mixture in the cell as that will cause

bubbles and the job is spoiled. Next take another dip on the wire and drop it *on* the object in the cell, this will fill an ordinary cell (the amount of liquid carried over, that is the size of the drop, depends on the size of the wire and the depth of the liquid in the bottle) full to the edges and much fuller at the center, as it will take a spherical form; next place a clean cover on the medium *centrally*, and allow it to fall down by its own weight. Should it not do this, then gentle pressure may be used on the center of the cover; be in no hurry, go slow, and when the cover is down fair and square on the cell, put on a spring clip and with a wooden needle holder handle, or some other similar tool, press the edge of the cover down into close contact with the top of the cell.

Clean off by absorbing the superfluous medium with bibulous paper. Take off the clip, place the slide on the turn-table, put a conical rifle bullet on the cover *centrally*, for a weight, then with camel's hair pencil and water, wash all around the cover, *clean*, dry with bibulous paper; then with camel's hair pencil and alcohol, or benzol, brush around the cover, this is to absorb all moisture, then with *hot* paraffine spin a seal ring of paraffine around the juncture of cover and cell and when this is cool and hard, the mount may be finished in the regular way, labelled and placed in the cabinet a "thing of beauty" and a "joy forever."

Interesting Little Aeronants.

By PROF. E. B. KNERR,
ATCHISON, KANS.

The spores of the common horsetail (Equisetum arveuse) are exceedingly interesting little aeronants. If the tip or cone of a ripe fertile frond be struck against a glass slip a shower of white dust will be observed to fall out. Place this just as it is without a cover under a half inch or inch objective and the dust will be seen

to consist of myriads of little spheres, most of them having four radiating arms. Now, while you are observing, breathe very gently over the glass slip, or better have a friend do this for you, and suddenly all the arms will contract about the spheres as if you had breathed into them a very spasm of life. Now watch the spores carefully a few seconds longer and you will see the arms gradually unfold again in quite a comical, cautious way.

The explanation of this peculiar power of the horsetail spores is not far to seek. The little arms are exceedingly hygroscopic and they expand very promptly to the moisture of the breath. Indeed I was greatly amused one day while observing their antics to see them keep ᵘp a slow waving twisting motion as though they were undecided as to whether they should remain expanded or fold about their precious charge. This puzzled me until I observed that the door to my room was open; and as the air outside was more moist than in doors, every little current as it came and went registered its influence on those sensitive little arms.

Each arm may be seen to have a spoon-shaped extremity which enabled the arms to cover the spore completely while yet green. Indeed, they then constituted the outer coat. As the spore ripens, its outer coat splits up into these arms and a dry wind readily detaches it from the spore case, bears it aloft and away until perchance it is wafted over a swampy place when the air is moist. The moisture causes the arms to fold about the bit of concentrated life in their charge, allowing our little aeronant to settle in a congenial place when it may multiply and replenish the earth with horse-tails.

Soluble Glass as a Mounting Medium.—Soluble glass sufficient to cover the specimen is used, the cover-glass is placed in position, and a hard brown varnish applied round the edge to fill up the intervening space under the slip, and so act as a cement to keep the cover-glass firmly fixed.—W. W. McBride.

THE MICROSCOPE.

New Series, 1893.

For Naturalists, Physicians, and Druggists, and Designed to Popularize Microscopy.

Published monthly. Price $1.00 per annum. Subscriptions should end with the year. The old series, consisting of 12 volumes (1881–1892), ended with December, 1892 Sets of the old series cannot be furnished. All correspondence, exchanges, and books for notice should be addressed to the Microscopical Publishing Co., Washington, D. C., U. S. A.

CHARLES W. SMILEY, A. M., EDITOR.

RECENT PUBLICATIONS.

Manual for the Study of Insects.—By John Henry Comstock, Professor of Entomology in Cornell University and in Leland Stanford Junior University.

This work has been prepared to meet the need for an elementary, systematic text-book for the use of students in high schools and colleges and of teachers in primary and secondary schools. Its most distinctive feature is a series of analytical keys by means of which the family to which any North American insect belongs can be determined. Under the head of each family the characteristics of the family, both as regards structure and habits are given, and the more common species described. It is thus possible for the student to classify any insect to its family and to learn the habits of the insects of that family, and, in case of the more common species, to learn the name of the insect.

The book is profusely illustrated with figures prepared especially for it. A large proportion of these were engraved from nature by Mrs. Comstock.

Although the book is a large one and gotten up in an expensive style it is sold for a nominal price, the preparation of it having been a work of love rather than a financial venture. It is hoped that its low price, $3.75 net or $4.09 postpaid, will bring it within the reach of all who desire to learn something of insects and their ways.

PRACTICAL SUGGESTIONS.

By L. A. WILLSON,

CLEVELAND, OHIO.

Indexing Slides.--It is very uncomfortable to be unable to find a particular slide when desired. To obviate an inconvenience of this kind it is well to number and index the slide, and also to label the boxes containing the slides with the box. A very little trouble in the direction here indicated will place every slide under control of its owner. Without some arrangement it is remarkable how soon a slide will become as a needle in a hay-stack. Little index books may be procured and are inexpensive. It is well to keep boxes with trays for slides in course of preparation. In such cases always write the name of the preparation on a slip of paper and keep it in the tray with the slide until it is permanently mounted.

Erysippei.—These are the powdery mill dews and this is the season for finding them on leaves. They are beautiful and compete favorably with diatoms as microscopic objects. Leaves will be found that look as if full of cobwebs or as if they had been whitewashed;—if they belong to this class, when in fu'l fruit, often with the eye or better with a lower power lens, innumerable little dark dots can be seen scattered through the whitewash or cobwebs on the leaves.

When the leaves are gathered it is well to press them at once.

On arriving at the microscope, with a spatula scrape off a few of the dark dots and transfer to a drop of water on a slide cover and examine with a low power. Then remove the slide, gently press on the cover with the finger and examine with a higher power about a quarter objective. With the low power the dark dots will be seen to be variously marked periehsia. Around the apothecia will be found the appendages by which the genera are classified. Some appendages are simple, some are long sharp spikes, some are shepherd crooks, some are long wth stars at the end. The pressure on the slide will mash the perithecia and expose the asci containing the spores. On the number of spores, specific distinctions are founded.

It it nice, neat, clean work which any miscoscopist with a little patience can accomplish. The U. S. agricultural depart-

ment and many state experiment stations pay a great deal of attention to the Erysippei as they are very destructive to the host of plants on which they quarter themselves. If on the first examination the appendages do not appear, try a new specimen. Often on transferring a specimen to a slip the appendages are broken off or rolled up so that the distinguishing ends cannot be seen.

White Zinc Cement.—Oxide of zinc rubbed up with equal parts of oil of turpentine and eight parts of solution of gum. Dammar in turpentine of a syrupy consistence, or Canada balsam, chloroform and oxide of zinc.

A clean satisfactory way may be effected by purchasing a tube of white z'nc from a dealer in supplies. Be sure and obtain white zinc and nothing else; dealers will inform purchasers that flake white or somthing else is just as good. To make a good c·ll, express a little of the white zinc on a flat hard surface, drop upon it a small amount of pure clear linseed oil; mix with a putty knife; when of proper consistence turn rings upon the turn table, using a very fine pointed painter's pencil. The proper consistence can be gained by experience only. If too thick the rings will not readily turn and if too thin the rings when turned will flow. If made properly, set the slides away until they are hard and dry, then they will be cells that are a comfort to the user. Mix a batch of the zinc whenever you wish to make cells; it does not seem to work well when mixed up and set away for future use.

Brunswick Black is asphalhem dissolved in turpentine. A little India-rubber dissolved in mineral naptha is sometimes added.

Preparation by Teasing.—A minute fragment of tissue should be placed in a drop of fluid on a slide, and torn or unravelled by two sharp needles. This is accomplished more easily after maceration, and sometimes it is necessary to macerate in a substance which will dissolve the connecting material. This picking or teasing should be slowly and accurately performed. Beginners often fail of a good preparation by ceasing too soon, as well as by having too large a specimen. The most delicate manipulation is required to isolate nerve cells and processes.

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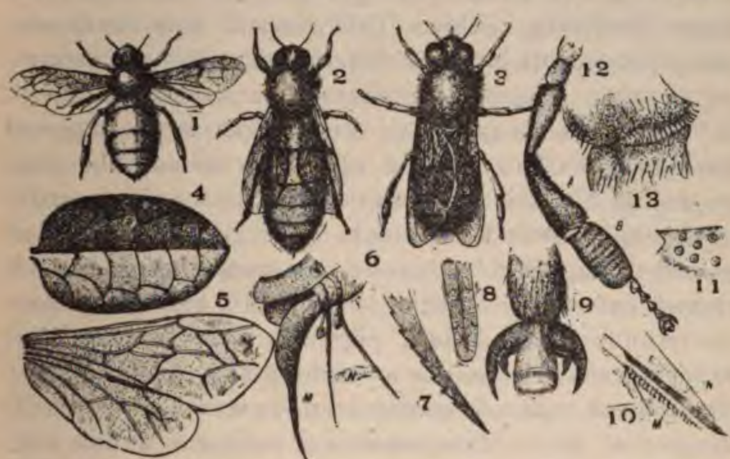
NUMBER 35. NEW SERIES.

Objects Seen Under the Microscope.

BY CHRYSANTHEMUM.

XXXVIII.—THE HONEY-BEE.

Much has been said of the wonderful skill displayed by the honey-bee in performing its domestic duties, but this skill is not more wonderful than is the bee itself when seen under the microscope. Of the Apis millifica or honey-bee there are three kinds in the hive: the males or drones, the female or queen and the neuters or worker-bees. The head of the worker-bee (fig. 1) closely re-



sembles that of the queen (fig. 2), while in the drone (fig. 3) the head is much larger, and the eyes are oval in shape and meet on the top of the head. The thorax of the queen is larger and more oval than that of the worker, while in the drone it is shield-shaped. But the

abdomen is the part which in the three types presents the greatest dissimilarity. In the worker it is small and oval, in the queen it is much longer and thicker, tapering to a point, while in the drone it is short, stout and oblong, having the posterior part fringed with long stiff hairs.

Examine the head with reflected light and a low power. There will be seen two compound eyes. Attached between these are two antennæ and at the front is the mouth. If a few of the hairs are removed from the back of the head, three simple eyes may also be seen (fig. 14, a).

The eyes.—The two compound eyes consist of thirty-two hundred single ocelli, each of which is composed of two remarkably formed lenses: the outer or corneal (fig. 16, a), and the inner or conical (fig. 16, b). The cornea is easily pealed off and the grouping of the lenses becomes distinctly visible. This corneal lens consists of two plano-convex lenses of different densities and refracting powers. The plane surfaces of these being adherent, it follows that the prismatic corneal lens is a compound double convex lens (fig. 16, a). How remarkable that we should find this same construction in the most perfect microscopical lenses of to-day. The light after it has passed through the lens crosses the vacant space (fig. 16, c) and enters the conical lens (fig. 16, b). This space is surrounded with a dark pigment, which is narrowed to form a round hole, like a diaphragm in a microscope). The colored matter is continued downward and surrounds the conical lens. This consists of a simple double convex lens. At the apex it comes in contact with the bulbous expansion of the optic nerve (fig. 16, e), which extends in a line continuous with the axis of the ocelli until it meets the nerve of the other eyelets. These three unite to form a common trunk which communicates with the insect's brain. Besides these compound eyes

there are three simple eyes which consist of one single lens (fig. 15) surrounded by little bulbous subdivisions of the optic nerve called papillæ.

The Antennæ.—These are composed of thirteen joints, the second from the head being much longer than the rest. With the exception of this joint all the segments of the antennæ are studded with perforations (fig. 8). Bleach one of these with chlorine and examine with a low power. It will be found to be covered with little sacs (fig. 11). Through the center of the antennæ the central nerve may be found, and with a high power little fibres may be seen branching from this and connecting with each of the little sacs, showing that they are organs of sense. Of which sense is not accurately known. Deprive a bee of both antennæ and its actions may be compared to those of an insane person.

The mouth.—The oral apparatus of the bee consists of two mandibles, two maxillæ, two labal palpi, and a ligula or tongue. The mandibles form the split pointed termination of the head. They may be seen separated at fig. 14, c, and are of a hard, dark, horny substance. They are formed and used much like a pair of toothed pincers. The maxallæ (fig. 14, d) consist of two long pointed blades, much resembling a pair of shears, but along the middle of each blade there runs a longitudinal rib covered with hairs. The blade is thin, transparent, and of a bright straw color, while the back is much thicker and stronger and supported by a series of transverse ribs. These instruments are used for cutting and molding the wax and in this operation they are aided by the ligula. This exquisitely formed instrument is composed of forty or more joints, which can be easily seen with a one-inch objective. These render the tongue perfectly flexible. At the end it is provided with a knob which is cartilaginous, the base is hollow and capable of inflation to a considerable size. In this hollow the nectar is collected

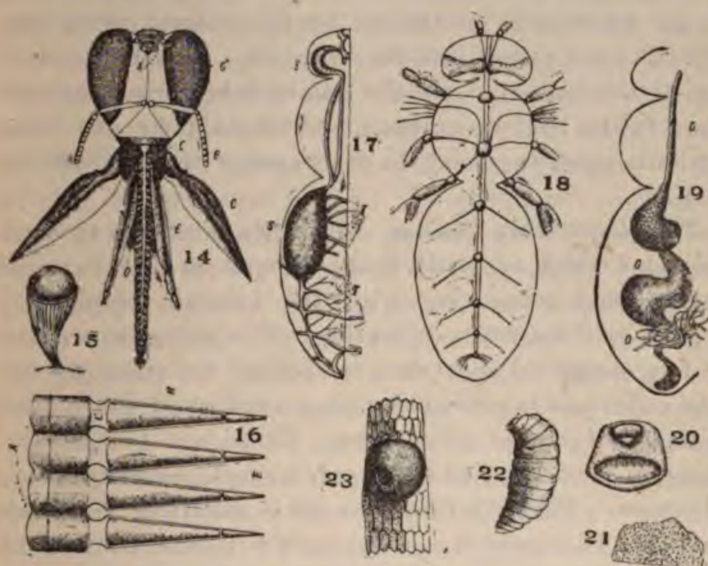
previous to its passing into the honey stomach. Extending the whole length of the tongue is a tube probably used for the passage of the nectar from the tip of the tongue to the mouth. While the tongue is stretched forth to collect the sweets from the flowers it is supported by the labial palpi (fig. 14, e), which are jointed and the lower segments covered with fine hairs.

To prepare the parts of the head for examination, soak for a fortnight in liquid polassæ to soften the skin and dissolve the fatty substance. Then wash in water, press between two pieces of glass until dry; drop a little turpentine upon them and let them soak in it a few days when they will mount well in Canada balsam.

The Legs.—In all bees the legs consist of five limbs, but in the worker-bee the fourth and fifth limbs of the hinder leg are very different from those of other bees. Examine these (fig. 12, a, b) with a low power. The tibia (fig. 12, a) becomes large as it approaches the tarsus (fig. 12, b), the first joint of which is very largely developed and covered with rings of stiff hairs set in regular rows. Where these two divisions of the leg come together a cavity is formed. This is the pollen basket. The inside of this cavity is smooth and around the upper edge is a row of lancet shaped hairs (fig. 13). These are straight on the side by which the pollen is received and curved on the opposite side in such a way as to prevent the pollen from falling out and at the same time to make the most room in the cavity. The right leg conveys the pollen to the left basket and vice versa. The foot of the bee is provided with forked claws (fig. 9) and with a central hollow cup-shaped organ studded all over with hairs. This is to aid her in walking on walls and smooth surfaces and is also used in performing her domestic operations.

The Wings.—These are four in number, the anterior pair being the larger (fig. 5). They are of a tough

membranous texture covered with fine hairs, and are furnished with nervures, with a set of vessels for the circulation of the blood, and another set for the circulation of air. That these wings may offer the broadest possible resistance to the air, the posterior pair are provided with a row of exquisitely formed hooks (fig. 10, m), while the anterior pair are provided with a rib or bar (fig. n) over which these hooks may be clapsed, thus forming an un-



broken surface. Bees use their wings to ventilate the hive much as we use fans.

The Sting.—What is usually known as the sting of the bee is really the sheath which contains the piercing apparatus (fig. 6, m). This consists of two long darts (fig. 6, n) barbed as shown in fig. 7, each barb having eight teeth; they are so placed when in use that the smooth edges come together, making a formidable weapon. At the base of the sting is a sac of poison which is operated by the same muscles as the sting. As the sheath con-

taining the weapons enters the flesh, a drop of poison passes down the hollow of the sheath into the wound causing instant death to the victim. In the queen the sting is curved and is also used as an ovipositor.

The Digestive System. From the mouth the food passes through the gullet (fig. 19, d) into the honey stomach (fig. 19, f). The part intended for honey is regurgetated and deposited in the honey cells, while that used for nourishment passes into the second stomach (fig. 19, g), where it is masticated by the gastric teeth (fig. 21). It then passes into the intestine. About the middle of the intestine are the biliary tubes, which correspond to the liver in animals, and these pour out their contents upon the food in its passage through the intestines.

The Respiratory System.—The bee breathes through spiracles which are little holes pierced in the external surface and connecting with the internal respiratory organs by little tubes or trachæ. The spiracles consist of two elongated apertures, one behind the other (fig. 20). The outer one is provided with a number of short hairs to keep out foreign substances. There are two pairs of these in the thorax and one pair in each segment of the abdomen. Through these the air is admitted to the air sacs (fig. 17, s) which communicate with one another by large trachæ (fig. 17, t). The abdomen being the heaviest it is provided with two large sacs, one on either side, from these extend trachæ to the other parts of the abdomen. The thorax being provided with wings has no air sacs but a large trachæ, which divides into two as it traverses the thorax. It connects the large air sacs of the abdomen with the smaller ones in the head, which are relatively large on account of the weight of the compound eyes. Thus the equilibrium is maintained throughout the whole body. The queen, whose abdomen is larger and heavier than that of the worker, but who

leaves the hive only once or twice during a lifetime, has no air sacs, the only air vessels being the large and small trachæ.

The Nervous System.—This consists of a pair of straight parallel chords of nerve substance that lie side by side and run along the whole ventral side of the body. Upon these chords are distributed several ganglia, resembling beads strung upon two strings (fig. 18). First there is the brain ganglion which is two fused into one and situated in the head above the throat. It sends out nerves to the compound eyes, the simple eyes and the feelers. The next centre sends nerves to the mouth and the first pair of legs. The central thoracic ganglion is the largest and supplies the nerves to the other four legs and to the wings. Behind this and in the abdomen are four of small proportions which give nerves to the different segments, whilst the last supplies the reproductive organs.

It has been stated that the air sacs are wanting in the queen bee, in their place two objects much resembling two bunches of grapes will be found. These are the ovaries and are composed of an assemblage of tubes collected in a bundle, closed at one end, the ether end opening into a common trunk called the "proper oviduct." These two ducts unite and form the "common oviduct" through which the eggs pass into the cells prepared for them by the worker bees. There are three kinds of these cells and the queen knows which eggs to deposit in the different cells. The queen cells are much larger than the others and are circular in form (fig. 23). The queen larvæ (fig. 22) are fed on different food from the others, but in case all the queen larvæ are destroyed a worker egg or a young larvæ may be transferred to a queen cell, fed on royal food and produce a queen bee.

The Dissecting Microscope.

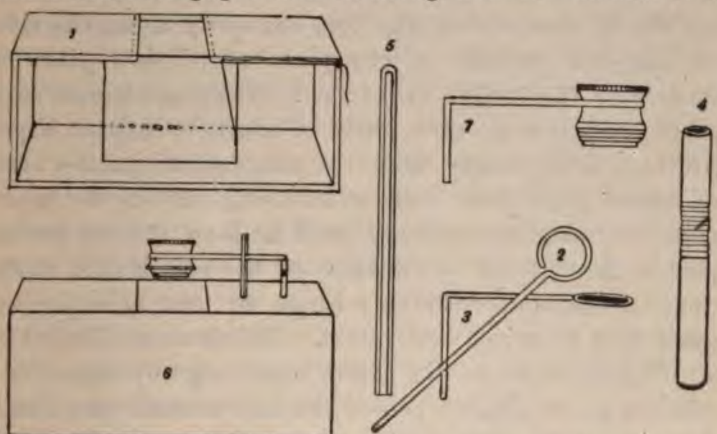
BY PROF. F. M. GOODMAN, PH.G.

To every student of botany a dissecting microscope is indispensable. There are several forms to be found in shops and this leads to frequent inquiry concerning the "best." When one is considering which is the best he is led to the consideration of the lenses, the construction of the hand rest, the method of supporting the lens and the means of altering its focus. The lenses usually employed in simple microscopes are either plano-convex or double-convex and lenses of these forms are subject to two inherent disorders; they distort the image and decompose light. The first is called spherical aberration, being occasioned by the sphericity of the lens. The second is chromatic aberration because the image seen by its aid shows a border of color not present in the object.

Spherical aberration may be overcome by making the lens much rounder on one side than on the other. This has the effect of rendering the rays of light from an object parallel and overcomes aberration of form. Using three lenses of the ordinary form tends to correct it, but the usual, because it is the cheapest, way is to place a diaphragm between the lenses, shutting out the peripheral rays and using only the central ones which are normally parallel. Chromatic aberration is overcome by cementing lenses of the proper form, of two kinds of glass together.

One combination of lenses which may be purchased of optical instrument makers is called the achromatic triplet. This is composed of three lenses of two kinds of glass, crown and flint, so adjusted in form and quantity as to overcome both aberrations. This gives exquisite definition and is justly regarded an excellent lens for a dissecting microscope, but it is quite expensive and the magnifying power is not increased over an ordinary

tripod, which costs but a trifle and as these are made containing two lenses, both double convex, one thicker and one thinner, they do excellent service. The lenses in the tripod are one and a quarter inches in diameter but are diaphragmed down to four or five eighths. The focal distance of the triplet and tripod may be the same and for the purpose of dissecting a one-inch focus is very useful as this is far enough from the working stage to allow of the free use of needles. One may estimate the focal distance of a lens or combination by holding it between a light and a sheet of white paper or between a window and a sheet of paper and noticing how far distant it is



from the paper when the image is clearest. It is well to do this when purchasing these lenses, as many of them focus at an inch and a quarter or more. Ten, divided by the focal distance, gives the magnifying power in diameters, ten is the distance in inches at which one usually holds an object for close inspection, the magnifying power of a lens of one inch focus is then ten diameters.

Having obtained the lens the next step is to mount it conveniently for use and this is one of the steps which every student should take for himself. The one used by the writer and which is here described, answers every

purpose and is more satisfactory on account of being home made and in costing but a trifle, than those for sale in the shops. The body is a tobacco box of the size holding six pounds of plug; it is about 4 by 5 and 13 inches long, made of sycamore with neatly dove-tailed corners. All particles of paper are carefully removed, the surface sandpapered and varnished, the inside is blackened with a mixture of lampblack and turpentine with sufficient varnish to prevent its rubbing off. This gives a dull black which is absorptive and non-reflective. Lay the box on its side with the bottom toward you and remove a section about three inches wide from the middle of what is now the top, cut away along the sides of this hole enough to let a piece of window glass in, flush with the surface of the box. The stage is now complete. Taking another piece of glass, or mirror if you prefer, a little larger than the stage glass, paste a strip of heavy paper, one inch wide, along one of the wider sides allowing it to project half an inch, the projecting part is then pasted to the back of the box, inside, at the upper angle, thus forming a hinge so that this piece of glass may be raised or lowered. This is accomplished by a string attached to the right hand edge by means of a piece of court plaster, passed through a small wire staple driven into the edge of the box near the stage and passed to the extreme right hand end.

When in use the open side of the box is turned toward the light and the glass reflector raised to the proper angle and retained by fastening the string. The stage and reflector are shown in figure one.

Next, unscrew the legs from the tripod and remove the band which carried them, make a neat loop with stout brass wire sufficiently large to encircle the body of the lens (fig. 2) and replace the lower band to hold the wire in place. Then, holding the lens perfectly horizontal,

bend the wire downward, at right angles, sharply, about four inches from the loop (fig. 3). This angle should be squared with a file. Now place the lens (fig. 7) over the center of the stage and at a point where the end of the wire touches the top of the box—toward the right—mark the place for the adjusting post. This is made of two pieces of brass tubing or gas pipe so cut with fine threads that one may be screwed into the other half or three-fourths of an inch (fig. 4), the outer piece of the two is now tightly fastened into a hole made at the point touched by the end of the wire, the inner is screwed into place and the wire is dropped into the hole through both, resting at its angle upon the upper edge. As the upper piece is turned, the wire carrying the lens is raised or lowered and is capable of very nice adjustment.

One thing more remains to be done. It will be noticed when the upper part of the adjusting post is turned the lens arm swings back and forth. This is overcome by taking another piece of the brass wire and making a long staple (fig. 5) to serve as a guide for the arm, the inner measurement of the staple is the same as the diameter of the arm wire, so that no motion is lost. This is secured in place by boring holes in the top of the box, the proper distant apart and forcing the legs of the staple into them. One finds plenty of room to work on this stage and ample rest for the hands. For dissecting use the ordinary handled needles and make one more by forcing the eye end of a good large needle into a pen stick, on a grindstone flatten two opposite sides for about half an inch from the point and continue grinding till a nice cutting edge is made, get this well sharpened and you have a most useful dissecting needle-knife.—*Graduate.*

Light.—The flame of the lamp used with the microscope may be intensified and improved by placing in the oil a small piece of gum camphor. The flame is thus rendered whiter and very brilliant. It is a good thing to do when resolving difficult diatoms.

THE MICROSCOPE.

New Series, 1893.

For Naturalists, Physicians, and Druggists, and Designed to Popularize Microscopy.

Published monthly. Price $1.00 per annum. Subscriptions should end with the year. The old series, consisting of 12 volumes (1881–1892), ended with December, 1892 Sets of the old series cannot be furnished. All correspondence, exchanges, and books for notice should be addressed to the Microscopical Publishing Co., Washington, D. C., U. S. A.

CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

Microbe of Scurvy.—Testi and Beri have succeeded in isolating from a piece of scorbutic gum a micro-organism, which they believe to be the cause of scurvy. The microbe stains in all the aniline dyes resists Gram's stain, is perfectly round, and generally united with one or more of its kind. Its culture renders gelatine fluid, and gives rise to a sawdust-like deposit. Inoculation of these cultures into guinea-pigs and rabbits gives rise to fever, and the necropsy showed hæmorrhagic stains in various parts of the body, and nodules of connective tissue new formation. Experiments were made in four cases, and in three out of the four the above mentioned results were obtained; in the fourth case the authors attribute their negative results to the fact that the patient had improved considerably under treatment. The diplococci found by the authors differ considerably from any that are usually present in the oral cavity of man.

Bacteriology in Australia.—The late Sir William Macleary bequeathed to the Sydney University money with which to found a chair of bacteriology, but the limitations being unsatisfactory to the latter the money was declined. Accordingly it has been given to the Linnæan Society of New South Wales which will maintain a bacteriologist and make investigations.

QUESTIONS ANSWERED.

NOTE.—*Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of all grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.*

232 *Where can I get slides of common rocks, or how can I make them?—A. P. S.*

Rock sections can be obtained from dealers in microscopical goods and material or may be ground as follows:

Select a thin fragment of rock, rub one side flat with No. 70 emery and water on an iron plate, smooth with flour emery. Wash, dry, and cement the flat surface to a piece of glass, with hard balsam, using a gentle heat. Grind the rock as before until thin enough to transmit light through the translucent elements. Much care is necessary as the section becomes thinner. Finally dissolve the balsam cement with benzol or chloroform, liberate the section, wash with care because many minerals are extremely brittle, mount in balsam. A section can be made in 20 to 30 minutes if you are not in a hurry.

233 *What is Hollis' Glue?*—Hollis' Glue is a solution of shellac in alcohol, *i. e.*, shellac varnish.

234 *Will a few drops of glycerine prevent the cracking of shellac cements?—If not, what will?*—Glycerine is not suitable. Add ten drops of castor oil or of Venice turpentine to each ounce of shellac varnish.

PRACTICAL SUGGESTIONS.

BY L. A. WILLSON,
CLEVELAND, OHIO.

How To Obtain Free Trichina.—Place a portion of the flesh containing encysted trichina in dilute hydrochloric Acid. This acid dissolves the lime of the capsule and leaves the animals free. Then they may be picked out with needles under a dissecting scope or hand magnifier. Before placing the flesh in the acid it should be well teased. After removal, the trichina should be bleached in chlorinated soda. They may also be stained. A section of a cat's tongue with stained trichina makes an attractive slide.

Tripethelium.—This is a lichen but the method of manipulating it is applicable to a very numerous class found on bark. This specimen is found frequently on beech bark. The bark affected will have a number of raised black spots. Under a low power these spots will be found to be little elevated warts with often a little hole (astiole) in the center. On the outer bark nothing worthy of a high power can be found. Shave off the upper surface of a small piece and cut down into the inner bark. Then where the warts were little spots will be seen. Dig out one of these spots; transfer to a drop of potassium hydrate on a glass slip; mash and spread out with a spatula; then cover and examine with a quarter objective. The contents are hyaline and glassy white. Numerous apothecia each containing eight spores will be seen. The spores are long, glassy and acicular and eight locular and each division of the spore is marked with a double convex lens shaped marking. The method here described is applicable to many bark lichens all the Verrucaria and also to many of the Pyrenomycetes. Many of the fungi which affect bark are superficial and need but to be scraped off to be seen.

Blood Showing the Effect of Tobacco.—The effect of the excessive use of tobacco can be clearly demonstrated by the examination of a properly spread slide of the patients blood. In such cases red corpuscles will be found to be crenated, that is the corpuscle instead of possessing the absolute regularity of margin noticed in health will present a series of scallops some what irregular in their distribution. A few such crenated corpuscles, in the proportion of one to three hundred and fifty occur in normal health but in tobacco blood the ratio is sometimes as high one degenerated corpuscle to ten healthy ones, and often attains a much larger proportion. Opium and other narcotics produce the same result. Nervous excitement, certain diseases will frequently produce crenation and the blood in dense urine will often be found in this state. Where the patient is otherwise healthy a number of crenated corpuscles in his blood, as above indicated, may safely be ascribed to the excessive use of tobacco, opium or some narcotic and it is then, high, time to stop their use.

SCIENCE-GOSSIP.

Hæmalum and Hæmacalcium Staining Solution.—Dr. Paul Mayer recommends the use of two staining solutions made from hæmatein, the essential staining constituent of logwood. When pure, hæmatein is a brown red powder, and crystallizes with one or three equivalents of water. It is most frequently found in commerce as hæmateinum crystallizatum, a compound of hæmatein and about 9 per cent. of ammonia, and is more properly designated ammonia-hæmatein. When pure, hæmatein and its ammonia compounds should not only be perfectly soluble in distilled water and alcohol, but should remain so on addition of acetic acid. From hæmatim is prepared a solution called for short, hæmalum.

One gram of the pigment is dissolved by aid of heat in 50 ccm. of 90 per cent alcohol and then added to a solution of 50 grm. of alum in 1 litre of distilled water. When cold it may be necessary to filter, but if the constituents have been pure this is quite superfluous. The solution is ready for use at once. It may be necessary to add a thymol crystal, in order to prevent the formation of fungi.

For staining sections hæmatin is used like Boshmer's hæmatoxylus, and if required the preparations may afterwards be washed with ordinary water, distilled water or 1 per cent alum solution.

Hæmacalcium, which is proposed as a substitute for Kleinenberg's hæmatoxylin, is made with the following ingredients: Hæmatein, or ammonia hæmatein, 1 gram; aluminium chloride, 1 gram; calcium chloride, 50 grams; acetic acid, 10 ccms; 70 per cent alcohol, 600 ccms.

The first two substances are rubbed together very intimately; the acetic acid and alcohol are then to be added, with or without the aid of heat. Last of all, the calcium chloride is added. The fluid is of a red violet hue. After having been washed in neutral 70 per cent alcohol, the preparations are violet or blue, and rarely require to be treated with acidulated alcohol. If too red they may be treated with 2 per cent aluminium chloride dissolved in acohol.—*Journal Royal Mic. Soc., Mittheil. Zool. Stat. zu Neapel.*

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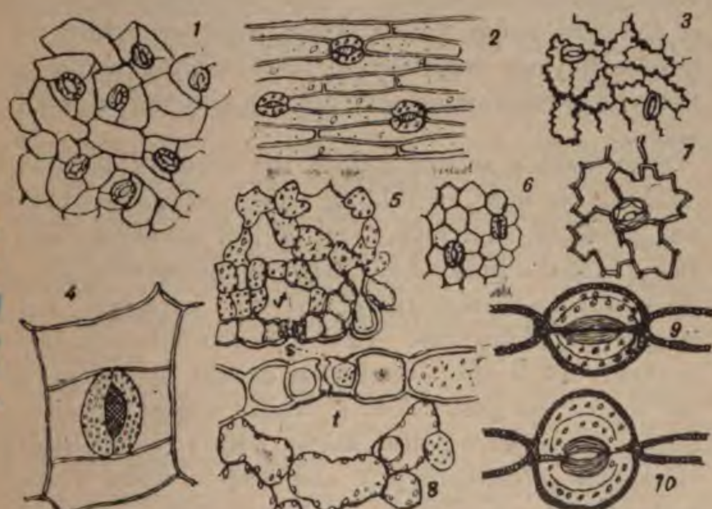
Objects Seen Under the Microscope.

BY CHRYSANTHEMUM.

XXIX.—STOMATA.

The leaves of all plants are covered with a skin or epidermis which is composed of cells varying in shape in different plants, and in addition to these the under side of the leaf is provided with openings called stomata or breathing pores.



From the under side of the leaf of the Wallflower (fig. 1) take a thin section and examine it in water. Many irregularly shaped cells will be seen and among these some of a half-moon shape, having an opening between them; these are the stomata. Fig. 2 is from the under surface of a leaf of the Iris, fig. 3 from the Lemna minor, fig. 4 from

Tradescantia virginica, fig. 6 from Water Crawfoot and fig. 7 from Hellebore. One may notice the difference in the shape of the epidermis cells in the different plants, also the different arrangement of the stomata; some are in rows running lengthwise of the plant (fig. 2) and some are scattered without order. In some cases they point invariably in one direction (fig. 6), while in others they may point in any direction (fig. 1). There is a great difference in the number of the stomata. The under side of the oat leaf has 2700 to a square centimetre, while on the under side of the olive leaf there are 63,500 to the square centimetre.

Each stomata consists of a pair of cells much smaller than those of the epidermis generally and of quite a different form. These two are called the guard cells. Each guard cell is sausage-shaped and curved, the ends of the cells being firmly joined together, while in the middle they are separated a little, leaving an opening between them which communicates with the intercellular spaces.

Now make a section across the stomata lengthwise. This may be done by holding a piece of the leaf between two pieces of elder pith, or if the leaf is very delicate use the pith of the sunflower. Make an incision in the pith by laying it on something flat and hard and cutting lengthwise of the pith. In this way it is less liable to be broken. Then insert the leaf so it will come just above the top of the pith; hold it firmly together with the fingers, or perhaps better, fasten with a rubber band and cut a slice across both pith and leaf to make a smooth surface. Now holding the pith so that the razor will cut along the flat surface and not the edge, cut several very thin sections and examine in water. You will probably find some sections showing the stomata cut through the center. This shows the two guard cells with the pore between (figs. 5 and 8, s). The transverse of the guard-cell is roughly square, the walls are very thick, especially

at the two corners towards the pore, which is provided with projecting ridges.

Each stomata opens into a large intercellular space called the air chamber (figs. 5 and 8, t). The air chambers communicate with the intercellular spaces of the leaf and through them with those of the whole plant. The stomata then are the pores by which the intercellular passages of the whole plant open into the external atmosphere.

The stomata have the power of opening and closing. As a rule they open under the influence of light and warmth and close when it is dark and cold, or they open when the guard cells are distended and close when they are relaxed. To prove this take a section of the amaryllis, which has a long stomata, from a living plant and place it in water under the microscope. The guard-cells will be seen to open more and more and the pore between them opens to its full extent (fig. 10). Now replace the water by a solution of salt—a strength of two per cent is sufficient. The curvature of the guard-cells now diminishes and as they straighten themselves the pore between them closes (fig. 9). The pure water is absorbed into the guard-cells by the denser cap-cells so their turgidity is increased, and the comparatively dense salt solution withdraws water from the guard-cells and thus they tend to collapse.

That the guard-cells become curved as they distend is due to the ridges by which each cell is strengthened on the side towards the pore. This side is more rigid than the other and so offers greater resistance to stretching when water is taken up. Hence the more inflated the guard-cells are, the more convex they become on the exterior and the more concave on the side next the pore, thus making the space between the two cells larger. But when the water is withdrawn the reverse happens.

To make a permanent mount first strip off the epidermis, and to prevent it from curling, spread it out quickly

on a slide and add a drop or two of alcohol. Let it remain until clear, then rinse in water, stain in ammonia carmine or iodine green. Then remove from the staining fluid, rinse in water, pass through weak, strong and absolute alcohol, then place in oil of cloves for a few moments and transfer to a slide. From the end of a wire drop sufficient xylol balsam to cover the specimen and allow it to settle of itself; then put on the cover, being careful not to entrap air bubbles.

The vegetable sections prepared by W. White may be used to advantage when fresh specimens are not available. These are already stained and mounted between gelatine films. They can be soaked in turpentine until clear and mounted in balsam as above.

On a New Method of Entrapping, Killing, Embedding and Orienting Infusoria and Other Very Small Objects for the Microtome.

BY JOHN A. RYDER.

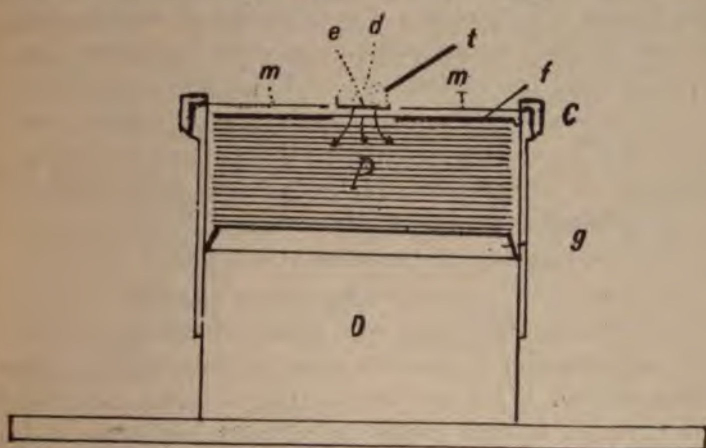
[Abstract of an article in the American Naturalist.]

A reliable method of capturing, killing, staining and dehydrating minute organisms has long been a desideratum with biologists, especially when such objects fall far below 1-100th of an inch in diameter. After trying a number of devices, I hit upon a plan that is not only very simple, but also capable of wide application, for by its means organisms as small as 1-2000th inch in diameter may be caught and held.

The filter upon which the objects are caught consists of thin slices of elder pith. Get good, clean, whole pieces of elder pith, and clamp a piece into the holder of a Schanze or other sledge microtome, so as to make transverse sections of it, taking four to six divisions of the microtome wheel to each section. The knife should be set at an acute angle with the line of movement of the knife car-

riage, as in cutting celloidin. With fresh pith somewhat thinner sections may be cut. Upon examination the slices will be found to be perforated at regular intervals by openings caused by cutting through the very thin cellulose walls of certain of the pith cells. A good supply of these little filters can be cut and kept ready for use at any time.

The next step is to cut some ordinary white filter paper into disks or squares one inch in diameter. With a damp tooth-pick moisten a point, about the size of one of the elder filters in the center of one of these disks. By means of a heated wire, saturate all except the central



moistened portion of this disk with paraffine. Prepare a discoidal pad, composed or ten or twenty superposed thicknesses of filter paper and upon these place the disk saturated with the paraffine. An ordinary, extra large live-box, provided with a mica cover, in the center of which a perforation 5-8 inch in diameter has been made, is a good device for holding the disks together. The accompanying figure shows the apparatus in vertical section.

The mode of operation is as follows: Place the pad of filter paper (P) upon the glass disk (G) of the live-box; lay the disk saturated with paraffine (f), upon P; put the

cap (C) with its centrally perforated mica cover (m m) in place and slip it down over the drum (D) so as to hold f down upon P. Then with a fine nozzled pipette moisten the central exposed part of f, and with a pair of fine forceps pick up one of the little disks of elder pith and lay it, convex side down, upon the center of f, when it will immediately flatten out and adhere to f, nearly covering the central area not covered with paraffine.

On placing a drop of water (d) swarming with animalcules on E, it will be found that the water will be rapidly drawn through e and f into P, in the direction indicated by the arrows. In this way several drops of water may have much of their animalcular population separated out and caught upon the surface of E. To kill the contents of D add a little saturated corrosive solution or osmic acid one per cent, by simply thrusting the charged end of a wooden rod (t) into the drop (d). The animalcules are at once precipitated upon the upper surface of E, where they are caught and held in the meshes of the pith cells. Remove the filter e by raising its free edge slightly with a needle, then grasp this edge with a pair of sharp pointed forceps and transfer to a watch glass containing 50 to 60 per cent alcohol. With gentle handling Ciliates may be passed through several reagents without becoming detached.

Even orientation may be very easily effected, either by sketching with a low power the outline of the whole disk and the position and direction of the axes of the very minute objects upon it, or by shaving down the block after the disk of pith is embedded so as to make it sufficiently transparent to show the shape of the adherent organisms through the semi-transparent block. The proper cutting planes may now be indicated on the margin with lithographic ink.

I have found it very easy to thus capture, hold, kill, dehydrate, stain, embed and cut Paramœcium aurelia.

Euplotes, Stylonychia and Halteria will also adhere to these disks. Halteria is about the size of a white blood-corpuscle, and the fact that it may be entrapped and treated as here described shows what a wide range of utility is promised by this method. It will doubtless be found useful in the study of minute eggs and larvæ.

I find that these disks may be mounted entire. One in this way may get most instructive preparations, often having a half dozen genera on a single slide. Staining is also entirely under control; any of the usual stains may be employed and their action watched under the microscope. With this method it has been found possible to cut 18 longitudinal and 50 transverse serial sections of Paramœcium with a thickness of 2.5 to 5 mm. with the Ryder Microtome set to one or two teeth of the wheel.

The fixation of the sections on the slide may be effected by means of Gustav Mann's albumen method. Take the white of an egg (30 c. c.), shake up with 300 c. c. of water for 5 minutes, filter twice. Paint clean slides on one side with this mixture by the aid of a glass rod and stand them on end to dry. The albumenized side of the dry slides may be distinguished by breathing upon them. The sections are stretched by floating the ribbon of paraffine containing them on warm water (30 c). Immerse one end of the albumenized slide in water and float and arrange the sections on it, albumemized side uppermost. Place the slide on a water bath to dry, when the paraffin may be removed with xylol or turpentine, after which the staining may be done on the slide. This method of fixing sections with albumen is much simpler and more practical than with Meyer's formula.

The novelty and simplicity of this new method, as well as its wide range of applicability will in many cases be found to materially facilitate work, especially the work of those engaged in the study of Protozoa, or of very minute ova or larvæ. A very simple form of this ap-

paratus, for holding the filtering paper in position, is being made and offered for sale by Chas. Lentz & Sons. —*American Naturalist.*

Appearance of Spontaneous Generation.

BY DR. BOUYON.

Translated from *Le Micrographe Preparateur* by Rene Samson.

When we bring into a narrow tube a very small pinch of Algæ, gathered with the end of a pole in a pond, in order to examine it under the microscope, we find a small number of species of animals; then, every day, we see new ones which before did not appear to be found there. Thus we can, after a few weeks' research, find, in a few cubic centimetres of water and a centigramme of filamentous Algæ almost one half of the ordinary Infusoria. No doubt that after a longer time we could still discover many others. This phenomenon is so striking, when we have made the experiment, that we are tempted to believe (as I have heard it taught in Paris) that all Infusoria arise one from the other, under ordinary exterior influences. It is necessary to know that Infusoria are as distinct one from the other as Entomostracæ or Mollusks; only, the same species can present natural or accidental forms which have been wrongly described, by the first microscopists, as so many different species.

We understand that, the first day, we cannot see them all: some species have passed unperceived; they are found again later. Besides, there are eggs, germs which were not yet hatched, and which produce new species the following week. And more, there often are transformations which require two or three weeks in which to take place, and a larva which we had taken for a perfect infusoria, can hatch and give birth at the end of twenty days to a new being, which seems fallen from heaven.

It is thus that if we observe a quantity of Oxytricha

crassa, which are superb Infusoria with long sticks, small horns and thick, slender and well visible cilia, we will find after some time some Trichoda lynceus, which are quite small and have a form which recalls this of the Cloportae. Never would we believe that such a beautiful Infusoria could be the larva of such an insignificant animal, which differs a little from the ordinary type of Infusoria.

If we think that all their transformations are not yet known, we will not be surprised at the continual renewal of what we have described as distinct species. When the water evaporates, the Infusoria die or are encysted. There again their forms change very much. If we add water again to the preparation, they continue to live under odd forms, which have caused them to be described as if they were durable. It is thus that we have mistaken certain cyclidium for Proteus tenax and so many other deliquescent Infusoria and Rhizopods for Amœba, of very distinct species. A little quantity of water is, indeed, sufficient to make an Infusoria or only a part of its protoplasm live under the amœboidal form. Certain Rhizopods, with soft body, not protected by a skeleton sustain thus complete modifications, which causes us to believe in the production of new Infusoria.

The Paramœcium aurelia can present, following a preliminary coupling, a series of olives disposed like a collar, which are simply spermatic capsules. It presents then a peculiar aspect which has probably been the cause of having it mistaken for another animal, with characteristic nucleus.

But they are still two beings of the same species, since they are two different forms of the same individual. At last, the wind which raises the germs of Infusoria, the rain which beats the roof and takes away its Systolides, the carpets shaken and which spread their dust, are three causes which add new Infusoria to the cultures ex-

posed in the open air, or window sill. It is then very natural to find in a preparation more different forms of Infusoria than there were to be found at first.

Caution to localities where typhoid fever is prevalent.—The germs of this disease are now known to be in the discharges from the bowels, and recently have been found in the urine; they are known to be in the spleen, and probably pervade the entire body, of a person having typhoid fever. The germs are not rapidly destroyed by drying. Typhoid fever is probably always spread directly from person to person.

All discharges from the body of a person having typhoid fever should be disinfected.

This is a time of extraordinary danger from typhoid fever, as has been predicted, since the low water in wells was apparent in June, July, August and September.

Prudence dictates that all drinking water, not known to be above suspicion, should be boiled, and cooled in some place where typhoid fever germs will not gain access to it.

Public notice of every infected place should be given, by placard on the premises and otherwise if necessary, so that no person may unguardedly drink water or take food from a source likely to be contaminated with the germs of typhoid fever.—Henry B. Baker.

A test demonstration of the new Electrical Projection Apparatus recently invented by Messrs. J. B. Colt & Co., of New York, including their new patent Automatic Feed Electric Lamp, Projection Microscope, Vertical attachment, Polariscope, etc., took place in Prof. Monroe's lecture room at the Columbian University, corner 15th and H streets, N. W., Washington, D. C., on November 4th, at 8 p. m. The apparatus is of the greatest scientific value and many most interesting experiments were tried. This exhibition was of very great value to those interested in the science of Projection. Henry H. Brown, 1010 F Street, N. W., is the Washington agent for Messrs. J. B. Colt & Co.

THE MICROSCOPE.

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CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

Pittsburg for 1896.—The Executive Committee of the American Microscopical Society has accepted the very kind invitation of the Iron City Microscopical Club, to meet in the City of Pittsburg, Pa., for the next annual meeting of the Society. We shall announce the exact date in next menth's issue.

Physicians' Visiting List for 1896.—We have just received from I. Blakiston, Son & Co., Philadelphia, the Physicians' Visiting List for 1896. This new edition presents several improvements. More space has been allowed for writting the names and to the "Memoranda Page;" a column has been added for the "Amount" of the weekly visits and a column for the "Ledger Page."

J. Tempere, 168, Rue Saint Antoine, Paris, has just issued a new Catalogue of microscopical preparations in all the branches of Natural History. That catalogue forms a book of seventy-five pages and contains a considerable number of objects. All the readers of the Microscopical Journals can apply for it, and will receive the Catalogue free.

Superstitions About the Microscope.—At a recent meeting of the St. Louis Microscopical Society one of the younger members, who is teaching histology, but who is still unsophisticated as to what is sometimes expected of microscopists,

related the following incident as a sample of *naiveté* of some medical practitioners when it comes to the judicious and unprejudiced appreciation of the merits and achievements of the microscope.

A physician had sent him a vial of purulent fluid, which had been gathered during the operation of a tumor of the breast, with the request of examining the liquid microscopically in order to determine whether the tumor was a carcinoma.

Similar requests are, in our experience, by no means infrequent. Some surgeons, and not only obscure ones, will remove with a curette a few cells of the mucous membrane of the uterus and expect of a microscopist to make an examination of the removed tissue and report whether the affection of the organ is of a malignant or a benign nature.

We have compared similar requests to the question of a student (?) of anatomy, who asked the demonstrator, after removing a piece of a nerve-trunk, "Professor, what nerve is this?"

Such occurrences, of which most histologists can cite parallel cases, form one of the arguments for the necessity of a microscopic training of all physicians, at least in a sufficient degree that the possibilities and impossibilities of an histological diagnosis are properly understood and appreciated.

While the very energetic use of a sharp curette may occasionally remove pieces of tissue large enough to exhibit the characteristic structure of a neoplasm so that a positive diagnosis can be made, the cases in which the tissue removed with a curette consists of a *pell mell* of tissue elements, without any indication of its architecture, are so predominating that the diagnosis based upon its examination is practically worthless. Such examinations, although they may in rare cases furnish presumptive evidence which, in connection with the clinical manifestations of disease, may lead the surgeon to arrive at a conclusion as to the necessary therapeutic procedure, are apt to bring microscopy into discredit. The removal by the curette of an abundance of epithelial cells or young connective tissue cells may lead a microscopist to suspect a carcinoma or a sarcoma, but a surgeon has no right to perform a radical operation upon such a mere suspicion, when it is an easy matter for him to remove a wedge-shaped piece of tissue large enough to make an exact histological diagnosis.

The neglect of insisting upon similar requisites for the purpose of arriving at a decision based upon an histological examination, as well as hasty examinations and the hasty expression of opinions are often detrimental to the proper estimation and appreciation of microscopy. Surgeons will sometimes ridicule the diagnosis of sarcoma by a microscopist, because the neoplasm rapidly improves under mercury and iodides; if they have themselves a passable knowledge of practical histology they will readily see how such a mistake may sometimes happen. These errors are not so apt to occur if the histologist has a properly prepared specimen and sufficient leisure to make a thorough examination. But such examinations require a familiarity with the subject. They take up much time, have great practical value and should be well remunerated.

The Suspension of "Insect Life."—This action was recently ordered by the Secretary of Agriculture and cuts off a valuable periodical. The reasons for the suspension were practically these:

1. The very commendable activity of other bureaus than that of entomology during the past few years had led their members to feel that they also could edit valuable periodicals, and they made known their desires to the Secretary. If Entomology had its monthly, why not all the other bureaus? The Secretary found it impossible to grant all the new requests for permission to print. He could not consistently grant to Entomology what he refused to others.

2. The general adoption of the periodical plan of publication by Government departments was likely to prove offensive to private publishers and became a killing sort of competition. How could private publishers compete against free Government issues? The Secretary very wisely decided not to enter the periodical publishing business as a destroyer of private enterprise.

The suspension occurring at about the time of Prof. Riley's death has led some to infer a connection between the events. Nothing could be further from the truth. Not only did Prof. Riley leave the Department a year ago but while he was in it, his connection with *Insect Life* was little more than nominal, the active management having always been in the hands of Prof. L. O. Howard, then assistant and now the Entomologist.

PRACTICAL SUGGESTIONS.

By L. A. WILLSON,
CLEVELAND, OHIO.

Yeast Cells.—The examination of yeast affords a fine study in cell formation.

For the purpose use a very small piece of compressed yeast,—a piece no larger than half a pin's head ; or scrape a very small portion from a cake of yeast. Place the portion scraped off on a plain glass slip, in a drop of water, cover and examine with a quarter inch objective. When the cake of yeast is used the yeast will be obscured by the large starch grains composing it. Remove most of the cells with the forceps before covering.

The yeast plant is Saccharomyces cerevisisae. Notice the mother cells and the daughter cells. These cells average .008 mm. or .0003 of an inch in diameter and reproduce the daughter cells by budding.

Another form is produced by division of the protoplasm within the parent cell. By gently heating the slide after it is covered, the process of budding may be accelerated and beautifully displayed upon the slide.

It may be better seen by keeping the covered slide in a warm moist chamber for some hours. The daughter cells may be developed by growing yeast upon fresh cut slices of potato kohl-rabi, carrot or upon small slabs of plaster of Paris. The preparations must be kept moist by covering with a bell jar and may be seen in a week or ten days from the beginning of the experiment.

Pus Cells.—It is interesting to examine pus by covering and examining with a quarter inch objective ; then remove the slide, lift the cover and place a drop of acetic acid upon the specimen, and examine. Upon the second examination each cell will exhibit from one to four nuclei.

Carbolic Acid for Mounting.—This is a valuable medium for mounting. Ordinary alcohol used in mounting insects makes them stiff and hard ; but carbolic acid penetrates the specimen and readily mixes with other fluids used in mounting, such as water, glycerine and Canada balsam.

It does not harden tissues nor make them stiff. For this reason insects can be preserved indefinitely in carbolic acid in a fit condition to be mounted at any time. The more delicate parts are rendered quite transparent by long soaking in the solution, but this is no detriment to them.

Carbolic acid is not an acid but belongs the chemical series of alcohols.

Insects are killed instantly by immersion in the acid and when thus killed their parts will generally be found to be spread out.

The carbolic acid used should be the strongest solution.

Obtain the crystals and dissolve them in just water enough to keep it fluid at ordinary temperatures. To use it for mounting it is only necessary to drop the specimen into the acid and in a few moments transfer it to the medium in which it is to be mounted.

India Rubber for Glycerine Mounts.—The following is said to act satisfactorily for glycerine mounts. Heat India-rubber till it becomes sticky; dissolve it in benzol, ring both cover and slide, then let it remain till tacky; arrange the object in glycerine, press down the cover, wash away spare glycerine and use asphalt varnish or other finish.

SCIENCE-GOSSIP.

Library Catalogues as a Possible Means of Infection.—The Independent says: "It is remarkable that in this day of germs and germicides nobody has invented a sanitary library card catalogue. Every one that recalls the unspeakable filth of the old and now departed card catalogue of the Astor Library must suspect that it was a highly-effective agency in the spreading of disease. The bound catalogue is perhaps even worse, for an attentive observer must often have noted that the average reader in a public library turns the leaves of the catalogue with the aid of a finger dampened by application to his own lips. The commercial exchange of germs by this method must reach a vast volume of transactions in the course of a year."

Photo-Micrography.—The art of photographing the image of a microscopic object, which image has been enlarged by the microscope, is called photo-micrography, in contradistinction to the art of producing microscopic photographs of large objects, which require the aid of a microscope to render the details visible. Dr. J. W. Draper, of New York, is supposed to have been the first to take photo-micrographs by the daguerreotype process, as he was the first to take portraits by this method, since which time thousands have probably practiced this art, abroad and at home. In this country Draper, Rood, Fowler, Deames, Rutherford, Seiler, Mercer and Col. Woodward, Drs. Curtis and Sternberg, of the army, stand prominent as masters of photo-micrography. The object of photo-micrography is to produce a faithful photograph of the enlarged image of a microscopic object, which shall not only show everything apart from color, that we can see in the microscope, but even more, as it is the most reliable and easy way of making faithful records of the appearances and measurements of microscopic objects. Be it for illustrations of scientific books or for lantern slides for lectures, or for supplying evidence in law courts in cases of adulteration, forgery, murder, etc., its importance is obvious. In the domain of botany, biology, physiology, pathology, bacteriology, chemistry, petrology, etc., and in fact, wherever the microscope is used, there photo-micrography is destined to become daily of more service and importance. The method of taking a photo-micrograph consists chiefly in the following operations. Focussing and illuminating the object in much the same way as for visual examination at the eye-piece end of the microscope, with the camera; focussing on the ground glass; replacing the latter by the holder containing the sensitive plate and making the exposure and finally developing the negative. To command success in photo-micrography requires not only the possession of a good microscopical apparatus and camera, but also an intimate acquaintance with the principles of microscopical illumination for photography, which depends for correctness first of all upon the choice of the illuminator, and secondly, upon the condenser and that of the objective, the rule being that the aperture of the condenser ought to be the same as that of the objective if we wish to obtain critical images.

THE MICROSCOPICAL JOURNAL.

Contents for December, 1895.

THE MICROSCOPE.

Contents for December, 1895

THE MICROSCOPE INDEX;

COMPILED BY HANS M. WILDER, PHILADELPHIA, PA.

LIST OF ILLUSTRATIONS.

THE MICROSCOPE.

AN ILLUSTRATED MONTHLY DESIGNED TO POPULARIZE THE SUBJECT OF MICROSCOPY.

Edited by

CHAS. W. SMILEY, A. M.

VOL. IV, NEW SERIES. (NOS. 37-48.)

1896.

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THE MICROSCOPE.

JANUARY, 1896.

NUMBER 37. NEW SERIES.

Objects Seen Under the Microscope.

BY CHRYSANTHEMUM.

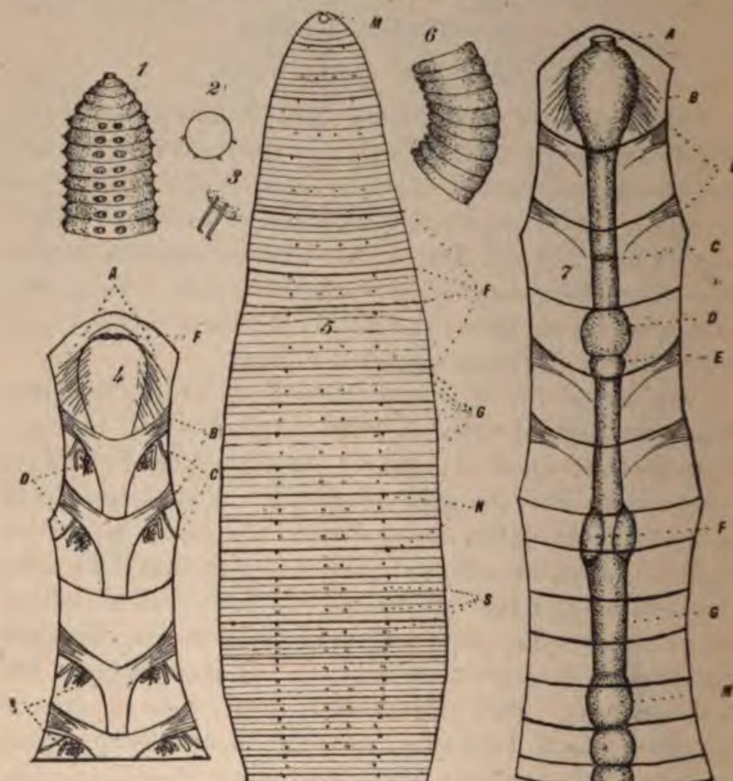
XXX.—THE EARTH-WORM.

Notice an earth-worm in the garden, how it winds rapidly along the ground, then thrusts its head into the soft earth and disappears. Examine it more closely and you perceive no feet, wings, fins, or limbs of any kind, only a long cylinder of soft flesh divided into numerous successive rings, and tapering at each extremity. Even the nose which penetrates the soil is not hard or bony but composed of the same soft kind of flesh.

Place the worm in a deep cell and put it under a low power of the microscope. The segments will be seen more distinctly and as it moves, on either side of its body, little spines may be seen advancing or receding from each segment. Also notice when the body is curved (figure 6) that the segments are larger at one side than at the other and that the spines are quite prominent at the smallest side. By careful focusing it may be seen that the spines are used in much the same way as the oars of a boat. This movement is better seen in one of the little worms found on decaying leaves in an aquarium, for here the body is so transparent that the action of the setæ is very plainly seen.

With a little chloroform kill one of the earth-worms and with a pair of sharp scissors cut out a small piece, say two or three segments, from a comparatively transparent part, wash it carefully, then press it between two slides and examine. You will probably see several

groups of hooked bristles resembling figure 3; these are the little points that projected from the sides of the body and are arranged so that the hooks point backwards thus keeping the animal from slipping. In the common earth-worm of our gardens these bristles or setæ are arranged with four groups to a segment and two bristles



in each group. There are two ventral groups and one on either side of the body (figure 1). Sometimes there are nine groups of setæ and there may be several bristles in each group. Sometimes they extend over the dorsal as well as the ventral side of the body. Sometimes they are arranged in regular rows as in figure 5, or they may

alternate and sometimes they are regular in the anterior part and alternate in the posterior but the ventral line usually remains the same throughout the body.

In figure 5, the worm is represented as having been cut down the back and laid open. The heavy lines (f) represent the divisions between the segments, while g represents the smaller divisions of these segments. Notice how many more small divisions there are in the first twenty segments from the head. This is the part which contains the vital organs and below these there are usually two lines of division only. This figure also shows the position of the setæ (figure 5, s) and of the nephridia or breathing pores (figure 5, n).

Now take the first five or six segments, soak in a little liquid potassæ, wash and press between two slides. One will probably be able to see the pharynx (figure 7, b) but certainly the strong muscles which move the head (figure 4, a). Take another head, cut it down the back and lay it open on the slide, then press. The septa or large muscles which move the body (figure 4, b) may be seen and sometimes the smaller ones (figure 4, e); but in nearly all specimens whether open or not little red conically shaped projections may be seen. These are the nephridia (figure 4, d). There are usually two of these in each segment and they are connected with a bunch of tubules (figure 4, e). The worm has a gland which answers the purpose of a heart and has a nervous system; figure 4 f shows the position of the cerebral ganglion, the principal gland of this system.

The digestive apparatus is divided into pharynx, œsophagus, gizzard and intestine. The food is taken into the mouth, thence it goes into the pharynx (figure 7, b), from there through the œsophagus (figure 7, c), and a portion of the intestine into the two-lobed gizzard (figure 7, d and e). From the gizzard the food passes through

the intestinal glands (figure 7, f) and thence through the single intestine to the saculated intestine (figure 7, m). Some species of worms have three gizzards and the number and arrangement of the sacs vary in the different species.

Although so seemingly insignificant, the worm is of benefit to man, for by its industry it keeps the ground mellow and leveled and prepares the dead grass and leaves for absorption by the soil. Worms vary greatly in size, some being microscopic while in Ceylon there is one which measures from 20 to 40 feet. They are found not only in the earth but in both salt and fresh water.

On a New Form of Mechanical Stage.

BY ARTHUR M. EDWARDS, M. D.,

NEWARK, N. J.

I wish to describe as well as I can without figures, a new form of mechanical stage which I have had put on my microscope. For it is a microscope without a mechanical stage itself, made with a fixed stage, a common kind of microscope. But I know that the new mechanical stage I am about to describe can be put on an expensive stand with advantage. It can be moved in any way that is desired and can be removed from the microscope stage and quickly replaced. It can be moved up and down by means of an extremely fine screw placed on either side. In this way it becomes a tilting stage also, making it useful when magnifying stereoscopically with even a one fifth objective. Besides these advantages it is cheap. I think it can be made by oneself—at least the one that I have was home made and I do not claim any superior mechanical skill.

A fixed stage three inches long by two inches broad with spring clip is used for holding it. This is of course

the ordinary fixed stage of a microscope. On this is placed the mechanical stage I am about to describe.

A slip of thick sheet brass, about one thirty-second of an inch thick is taken. It is six inches long and three inches wide. It is also provided with spring clips to hold the object on. It is bent at the two ends so as to make a double stage like a V at each end, leaving about a half an inch between the upper and the lower portions. On each v-piece two cuts are made so that on each side a portion is left which is bent up so as to make a spring to bear the stage downwards. Acting against the two pieces are two fine screws fixed in the bent v-shaped part. These screws have large heads to use with the fingers, first the right and then the left. Of course there is a hole about a half of an inch in the centre of the mechanical stage to view the object with and opposite the hole in the centre of the fixed stage-proper.

Now when in use it is placed on the fixed stage. When the object on a slide is placed on it under the spring clips, it can be moved about up or down, transversely and from right to left. It can likewise be moved the same way as the objective by the screws and the springs acting against them. It can be entirely removed and the fixed stage used alone. It can also have index marked on it and the fixed stage marked with fiftieths of an inch up and down and transversely so that the object can be indexed. In fact I think it is simple and cheap and also effective. I wish it could be tried.

Eggs of Bot Fly.—The eggs of the bot fly (gasterophilus equi) mounted attached to the hair make very pretty transparent or preferably opaque objects. They may be found in abundance on farms where horses are raised, especially on horses that have long run in the fields. The eggs are deposited on the hairs generally of the forelegs and mane, whence they are taken into the mouth and swallowed. The larvæ are hatched in the stomach.

On Identifying Minerals.

By MELVILLE ATWOOD,
SAN FRANCISCO, CAL.

[Report of a paper read before the San Francisco Microscopical Society.]

The minerals which have been generally adopted as representing the degree of hardness in minerals were suggested and introduced by Mohs, and are as follows: Talc 1, rode salt 2, calc-spar 3, fluor-spar 4, apatite or wolfram 5, feld-spar 6, quartz 7, topaz 8, sapphire 9, diamond 10.

Many years ago the speaker had found considerable difficulty in determining, with any degree of accuracy, the hardness of minerals, the scale of hardness then in use, and probably still at many colleges, being a small box containing samples of the different minerals and a penknife. The knife was seldom hard enough to scratch wolfram representing 5 in the scale. To the prospector or miner it is of the greatest importance to be able by some simple means to determine the degree of hardness. Many fragments of corundum and quartz have been sent long distances to have them determined, the sender thinking them diamonds.

It had been found, after many trials, that the easiest mode of determining hardness was to have the minerals representing the various degrees mounted something like a writing diamond. For this purpose break the corundum, topaz, etc., into small fragments, and after selecting those with fine, sharp points, proceed to mount them in the following manner: Take a small rubber-tipped pencil and extract the rubber from it. Then with a spirit lamp melt some lapidary's cement into the vacant space; with a small pair of plyers take the fragments of minerals, heat one end, and insert it into the cement. While the cement is warm, by wetting your finger, you can mold it into any shape you please; and when cold, it will harden and answer just as well as if set in metal, with the advan-

tage that you can renew it at any time in a few moments.

In the examination of rocks the specimen selected should have a good, fresh surface of fracture, of a size about 3 by 5 inches, and 1½ inches thick. With a trimming hammer prepare the narrow face or edge, so that by rubbing it on emery blocks you can get an even surface or polish on it. Then heat the specimen so you can hardly handle it. When in that condition rub Canada balsam on half of the polished surface. When cold it will harden so that you can handle it without injury. By this method the different constituents of the rock are much better seen, and the inspection of the outer surface, viewed as an opaque object with a common magnifier, say of three diameters, set in a spectacle frame, gives all the information ordinarily required by the mining engineer. The even surface not covered by the balsam can then have the hardness of the different crystallized minerals to be seen on it easily determined, and also treated with acids, applying the same with a pointed glass rod dipped in the acid. The action, if any, can be seen, and also the smallest scratch, when testing for hardness, will be made visible.

The use of the lenses mounted in a spectacle frame is recommended to the miner or geologist in the field, as it is scarcely possible to examine the streaks of minerals when they occur in very minute crystals and keep the lens in focus when holding it in one hand and working for the scale of hardness with the other.

There was shown under the microscope a small fragment of what is called "carbonate," or diamond carbon. Bahia, Brazil, produced at one time large quantities of the carbonate. Its hardness is identical with the white diamond, and in structure it is porous, so much so that it resemble pumice stone. This fragment was taken from the Yellow Jacket diamond drill, at Virginia City, Nev. The drill penetrated the rock below the gold and silver

ores of the Comstock lode at a depth of over 3,000 feet, when they met with hot water.

Should the minerals forming the rock be too small to be seen with the common lens, a microscopic section will have to be cut. The process is a simple one, but requires patient and skillful treatment to produce a section thin enough for a full view of its structure. Mr. Atwood had two sections thus prepared from the hanging wall of the Keyston mine, Amador county, at the thousand-foot level, one to show color and texture, the other to be examined by polarized light.

The Microscope as a Detective.—The other day there was a great robbery in South Africa of gold coins from a mail-cart. They had been consigned in wooden cases. The thieves took the gold out and filled the cases with sand. The police have been unable to discover where this exchange was made. Why not employ the microscope? Some years ago Ehrenberg, that old prince of microscopists, was employed by the Prussian Government to investigate a case of smuggling. A cask had been opened, valuables extracted, and the case repacked and shipped onward to its destination. The only clue to the criminals was that the unpacking must have been done at some of the custom houses through which the goods passed.

To all appearance the microscope had a hopeless task. But not so. Ehrenberg took some of the sand that had been used in the repacking, placed it under his microscope, looked through his magic tube, and behold! there on the stand lay a peculiar specimen of foraminifera. That animal was found at only one place in the world, and told just where the crime had been committed. Possibly an examination of the sand found in the South African cases, seeing they had travelled a great distance, might by chance reveal the particular point in the route where the theft took place, and thus lead the police to the trail of the robbers.—*Science Siftings.*

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CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

Romance.—On the first of January, 1896, the magazine "Romance," which has heretofore been devoted to fiction entirely, underwent a complete change and was issued as a five-cent magazine, filled with illustrations of a popular kind. The magazine will be a considerable novelty; the idea being to emphasize the illustrated side of it rather than the text. There will be 48 pages containing not less than 60 illustrations, printed from the best of plates on the best of paper. There will be pictures of noted painters, of people of the day, of literary individuals at home. Scientific matters will be treated of, and amateur photography will be given a generous space.

The Tolles Microscopic Objective.—Ephraim Cutter, M. D., LL. D., of New York, assisted by Charles X. Dalton, of Boston, exhibited the famous Tolles one-seventy-fifth microscopic objective to the members of the regular monthly meeting of the New England Association of Opticians at Young's Hotel last month. The exhibition was very interesting.

An experiment was performed by drawing a small drop of blood from Dr. Harriman, and allowing the spectators to see it. The meeting was presided over by President Charles A. French. The committee having charge of the exhibition consisted of Edwin P. Wells, chairman; Leslie Millar and W. H. Doleman.

Dr. Cutter said that Mr. Tolles was three years constructing the lens for Dr. Harriman, who paid $400 for it. After he had solved the problem on which he was working, Dr. Harriman sold the objective to Dr. Cutter. Mr. Dalton who assisted Dr. Cutter, was Mr. Tolles' partner and succeeded to the business after Mr. Tolles' death.

At the business meeting of the association, George H. Lloyd resigned the office of treasurer, as he expects to go South for the winter, and A. H. Martin, of Boston, was chosen to succeed him. J. E. Whiting of Andover, Mass., and Frank and Carlos Huckins, of Ashland, N. H., were elected members.

The committee on the Tolles Memorial reported favorable progress, stating that some money had been collected. It was announced that Dr. Williams, of Boston, would speak at the next meeting of the association. Dr. Cutter offered to give in Boston a public exhibition of views taken with his objective, the proceeds to be devoted to the Tolles Memorial Fund.

The treasurer of the Tolles Monument Fund reports that he has received $100 up to Dec. 1.

A. J. Landry	$1.00
W. R. Donovan	2.00
E. M. Parks	2.00
Charles A. French	5.00
Dr. George B. Harriman	10.00
W. G. Corthell	1.00
F. H. Blackington	2.00
John W. Sanborn	10.00
A. G. Barber	5.00
Geo. H. Lloyd	10.00
E. G. Worthley	1.00
R. H. Wigler.	1.00

B. V. Howe, Treasurer.

Staining Milk Vessels of Plants.—Chimani (Archiv Pharm.) finds a combination of alkanin and acetic acid very serviceable for differentiating the sieve-tubes and tannin sheaths. He extracts extract of alkanet with ether, dispels the ether, treats the residue with 45-per cent glacial acetic acid, and lastly, slightly concentrates the resulting acetic acid alkanin solution by evaporation on the water-bath. This stain acts both on dry and fresh plant parts.

QUESTIONS ANSWERED.

NOTE.—*Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of all grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.*

232 *Outside of Carpenter's work, which author has the most explicit directions for staining and mounting sections?*—D. E. L.

Clark's Practical Methods in Microscopy gives detailed directions for staining and mounting sections. Cole's Methods of Microscopical Research, last (1895) edition, is a very practical work. Gage's book does not give directions for staining sections.

233 *I have a Zeiss Binocular Eyepiece. It was damaged in transit and was repaired by B. & L. The left eyepiece does not show the object distinctly, and shows also two margins close together of every object. Is this a necessary result of the double prism, or can it be corrected?*—D. A. N.

There are two prisms in the *axial tube* beneath the axial eyepiece, which should be very nearly in contact (within 1-2500 inch). This less than optical contact causes part of the cone of rays to go to the left. If there is any great separation of the prisms some of the rays will be reflected from the inner "surface" of the lower prism and some rays will be reflected from first the surface of the upper prism and these two images will not co-incide in the left eyepiece. The image in the left or lateral eyepiece should be distinct, but not quite as bright as in the axial or direct eyepiece.

PRACTICAL SUGGESTIONS.

BY L. A. WILLSON,
CLEVELAND, OHIO.

Mushroom Spores.—The agariani or gill bearing fungi are classified according to the color of their spores. To obtain the spores, separate the stem from the pileus or cap, and invert the latter with the gills downward, upon a piece of glass or white writing paper. In the course of an hour or two the spores will be found on the glass or paper. Place a few in a

drop of water on a slide cover and examine with a quarter objective. It has been said of these spores, "they are infinite"—for in a single mushroom 10,000,000 have been visible.

Revolving the Turn Table.—When preparing several slides it is often desirable to cause the turn table to revolve rapidly and to do so without the constant use of the finger.

One way is to wind a string around the shaft and quickly jerk it off as a top is spun.

Where a large number of slides are to be prepared the table may be made to revolve with a toy steam engine or electric motor.

How to Obtain Objects at Home in Winter.—A microscopist, unable on account of winter, to scour the fields and woods in search of objects can obtain an endless supply of amusement and instruction by examining the water supply. Nearly every month will display a new flora and fauna that will furnish ample problems for solution. The examination of textile fabrics and of different kind of hair will cause many an hour to pass pleasantly away. Then in winter the making of slides of crystals and crystalizations for the polariscope will be time well spent.

SCIENCE-GOSSIP.

Examination of Spots on Clothing for Spermatozoids.—Those who have had to conduct such examinations know how difficult the investigation becomes when the material is very porous, and will welcome the following suggestions of De Nobele: Cut the material into two little scraps, and place the latter, with the stained surface downward, into a 1 per cent. solution of sodium chloride, or in distilled water carrying one-half of one per cent (1 : 200) of alcohol. Let it remain for several hours, or say over night, and then remove each scrap separately and press between a slip and cover-glass. Dry slips and covers, and after drying plunge for a moment into a 1 per cent solution of fuchin. If spermatozoids are present they can be found with great readiness in this way.—*Nat. Druggist.*

The Examination of Pepper.—W. Busse, in *Mittheilungen der Gesundheitsamt*, states that most of the analytical methods for the valuation of pepper, such as the determination of the moisture, ethereal oil, mineral matter, alkalies, and phosphoric acid, are inconclusive, since these constituents are common to the seed and the husk. The value of the cellulose and dextrose estimations must also be called in question. On the other hand, the brown coloring substances are only found in the husk, and their quantitative estimation will show the value of the pepper. To isolate them the following method is proposed: Five grams of the sifted and dried pepper are treated with boiling absolute alcohol. The residue, after being freed from alcohol in the drying oven, is ground up with a little water in a basin, and then washed into a flask with 50 to 60 c.c. of boiling water. Twenty-five c.c. of a 10 per cent solution of soda are added, and the flask is warmed on the water-bath for five hours with constant shaking. Concentrated acetic acid is next added until the liquid is only feebly alkaline, then 250 c.c. of water, and the flask is well shaken. After twelve hours the liquor is filtered with the aid of a suction-pump. To 50 c.c. of the filtrate concentrated acetic acid is added to acid reaction, followed by 20 c.c. of a ten per cent solution of lead acetate in dilute acetic acid. After mixing, the liquid is diluted to a 100 c.c. with water, well shaken and filtered. Ten c.c. of the filtrate are decomposed with 5 c.c of H_2SO_4 (1:3) and 30 c.c. of alcohol, the precipitate filtered after some time, washed with alcohol, and the lead sulphate ignited and weighed in the usual manner, and the amount of lead calculated. The amount of lead (in grams) which has been obtained by the process from 1 gram of dried pepper, may be described as the "lead number." The figures given by the different kinds of pepper are:

	Lead Number.
White pepper	0.006 to 0.027
Black pepper	0.054 " 0.075
Husks	0.129 " 0.157
Pepper dust	0.109 " 0.122

The author concludes that this method, taken in conjunction with the determination of the ash and sand and the microscopical examination, should be of great assistance in estimating the value of pepper.—Analyist.

THE MICROSCOPE.

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FEBRUARY, 1896.

NUMBER 38. NEW SERIES.

The Spoiling of Fermented Drinks.

BY A. DEROS.

Translated from Le Micrographe Preparateur.

THE BLUE INFECTION.—This alteration, although very rare in red wines, is quite common in the white wines, since the grape vines have become infested with many different species of mushrooms. The flat wines, containing little acid or alcohol, are most susceptible to this change, especially if they are rich in nitrogenous substances. Wines which should be clear when drawn, then become muddy and of a bluish color when looked through. M. Robinet attributes this change to the presence of mycodermes having a strong resemblance to mycoderma aceti. With a high power of magnification the presence of grayish mycodermes, which multiply by budding, can be distinguished in these blue wines.

To counteract this blueness, add to the wine a quantity of alcohol sufficient to bring it up to 12 degrees; the acidity can also be brought back to five grammes by the addition of citric acid. If the disease resists this, it will be necessary to add six or eight grammes of tannin to the hectolitre and afterwards make a strong *collage*.

THE GREASY INFECTION.—White wines, champagne in particular, sometimes become sticky, slimy, stringy, and quite unfit to drink. This change takes place not only in wines in casks but also in bottled wines which are properly corked and cared for. It is the grease.

There is produced in the wine a particularly sticky substance, which has been called gluten, gliadin, *glaia-*

dine and finally *viscose*. Where does the substance come from? Did it pre-exist in the wine in some soluble form, and was it brought forth to be precipitated in this sticky appearance by which we know it? This opinion, held by some scientists, seems now to have been abandoned.

It is admitted that the *viscose* is the product of the evolution of a special ferment in the same way as alcohol and carbonic acid are products of Saccharomyces; but there is a difference in opinion upon the nature of the ferment which produces the *viscose*.

M. Krammer (*Annales agronomiques*, 1890) has cultivated in sterilized wine a ferment formed of very fine

1

2

elongated sticks. This ferment planted in the sterilized wines renders them viscid at the end of one or two months.

Pasteur has found in all the wines affected as are these which we are studying, a ferment formed of round globules which are not more than one micron in diameter, very rarely isolated and more often united in long flexible chains (fig. 1). It is to this ferment that nearly all connoisseurs attribute the formation of *viscose*.

When it is developed in wine in the casks, a fraction of it forms a scum on the surface, while the remainder is deposited at the bottom. When found in wine in bottles

it does not form a scum but the greater part is deposited, while the rest is mixed with the liquid.

The best remedy for this grease is to add to each hectolitre of the wine, from five to ten grammes of tannin dissolved in alcohol, and after mixing thoroughly let it settle for some time to form a good *collage*.

THE BITTER INFECTION.—This disease, which attacks by preference the fine wines of Burgundy, shows itself only when the wine is old. The wine at first loses its flavor, then becomes bitter, and throws off a peculiar odor, the coloring matter is altered and forms a deposit. At this time the wine becomes undrinkable, but as this change is only produced slowly, if it can be arrested when the bitterness commences to manifest itself, the wine may still be excellent. (Pasteur.)

At the same time a bitter substance, which Maumené thought to be aldehyde of ammonia, and which other chemists believed to be citric ether, is formed in quite large quantities from the carbonic acid. The acidity of the wine increases, at least that part furnished by the volatile acids, and in particular by the *etique* acid and the *butyrate*.

The alteration is chiefly in the coloring matter and in the tannin, and it also appears in the glycerine.

The bitterness is due to a ferment discovered by Pasteur. In the deposit which forms in the diseased wine numerous long and very slender sticks are found. These sticks form articulated filaments; the articulations are rigid and the branches irregular. The ferment is often associated with crystals or with little mammillated masses. It is generally impregnated with coloring matter (fig. 2). One can, by treatment with alcohol or acidulated water, carry off with the ferment the foreign matters which soil it. It then takes its original appearance.

When the bitterness first appears in a wine it can be

saved by making it into brandy. Some authors recommend putting alcohol in the wine and the addition of tannin, but making it into brandy is especially recommended.

We will now review the impairments of wine which have been most thoroughly studied. Many of these have been confounded and taken the one for the other. It will be understood besides that the definite products of the evolution of the microbes which occasion them can vary with the nature of the unfermented wine, the temperature, &c. In certain cases, several of these minute organisms may develop at the same time, and give us as final results products much more complex than when they are isolated.

Also some changes in the wines may come from diseases in the grapes from which they were made, for example, the musty taste of wine, made of grapes attacked with mildew.

The diseases of wine, whether studied or not, come from the presence of micro-organisms, and the conclusion to be drawn is that great watchfulness is necessary, that the most scrupulous cleanliness ought to be maintained in the casks and in the cellars and also in the materials used. Finally when in spite of all these precautions a change manifests itself, it is not necessary to hesitate to act, the procedure the most sure to cut short the ravages which threaten, is without doubt, making it into brandy by Pasteurization.

Correction.—In my paper on a new form of mechanical stage in the January number, I speak of "a double stage like a V at each end." It should read, "like a U at each end."—Arthur M. Edwards, M. D.

Fermentation of Bread.

K. E. GOLDEN.

LAFAYETTE, IND.

The production of bread is of vital importance to a people, as it furnishes so large a part of their diet, this being specially true of fermented bread. While the baking powder companies have advertised so extensively and gotten cooking school teachers to advocate their wares so persistently, the majority of the people still insist on preferring the fermented bread. Yet, compared with other articles of diet, it has received very little attention from the scientific point of view. People are content to take what they can get from the bakers, or else to cling to the old methods of making it at home. Scientists abroad have studied the fermentation of bread to determine what caused it, this being specially true of the leavened breads. But little attention has been given to the subject from the point of view of making better bread, and of controling the fermentation by determining what organisms caused it, then using only those organisms from which most desirable results could be obtained.

Work of this nature has been taken up by investigators on beer, and now brewing is reduced to a science. The work in this direction is of comparatively recent date, but a great deal has been done, as was to be expected from such men as Pasteur and Reess, and at the present time, Hansen. At first thought there does not seem to be much connection between the art of bread-making and that of brewing, but that there is a very close one, has been amply demonstrated.

Bread-making is of very ancient origin; our prehistoric ancestors knew the art as early as the Stone Period, as excavations made on the site of the lake dwellings in Switzerland have given proof, and witness also its frequent mention in the Bible. The Egyptians were well

up in the art; they baked cakes and loaves of various shapes and varieties, using several kinds of flour, which they flavored with aromatic ingredients. From these the art spread over Europe, the people of the several countries taking to it eagerly, except those in the extreme north, and even to this day it is carried on sparingly there.

Many changes have come in the manipulation, and attempts have been made to use other methods for lightening the bread. Where chemicals have been introduced into the dough to generate the gas in it, the bread must be eaten while fresh to be palatable; and aeration gives a tasteless bread. But taken all in all, we are not so far ahead of the ancients in the matter of fermenting the dough. In the matter of preparing the flour great progress has been made.

Fermentation consists, essentially, in the breaking up of chemical compounds, the molecules being separated and recombined into more stable compounds. The fermentation is always accompanied by a rise in the temperature; this can be noted easily by plunging a thermometer into rising dough, or a fermenting liquid. The fermentation in bread is the same as that in beer and other fermented beverages—an alcoholic one. It consists in the breaking up of the molecules of sugar into CO_2, alcohol, succinic acid, glycerine, and a number of bye products, which vary in quantity and nature with the kind of yeast used, and the conditions under which growth has taken place.

There are other ways of fermenting bread than by means of yeast. The old method being to mix together flour, water or milk, and mashed potatoes, the potatoes being a good food for micro-organisms, the dough being then allowed to stand until a spontaneous fermentation had taken place. This method is still practised in country places where yeast is difficult to obtain, and is the same process as the leavening of the ancients. A quantity of

the leavened dough is saved usually for the next baking to facilitate the action.

Another form of this spontaneous fermentation is carried on in what is known as a salt-rising bread. In this the fermentation is brought about by micro-organisms, it not being known which one or ones produce the alcoholic fermentation. In some experiments which I made on salt-rising bread, in no case was yeast or any of the budding fungi found, but in every case large numbers of bacteria, four different kinds being constant. That is, in plate cultures made from rising dough, there were four forms that differed from one another in various respects that were always found. Other forms beside these were found sometimes, but were not constant.

In the manufacture of bread as ordinarily carried on some form of "pressed yeast" is used, either the moist or the dry. The dry cakes usually have a small amount of yeast and a large amount of corn meal or some flour. The moist has a large amount of yeast, and a small amount of starch, usually that of the potato. The yeast is S. cerevisiæ, or brewers' yeast.

Yeast is a unicellular plant, without chlorophyll, thus belonging to the fungi. The cells are round, oval, or in some species very much elongated. The cells consist of a definite cell-wall, which encloses a mass of granular protoplasm. The wall consists of cellulose, which is somewhat delicate in young growing cells, but much thicker in old or resting cells. In the protoplasm are a number of vacuoles, a nucleus is present, but is difficult to see, so that special treatment has to be given for its demonstration. Yeast reproduces ordinarily by budding.

When the yeast is placed under favorable conditions for growth, the wall of the cell, usually near one the poles, bulges out; into this, protoplasm presses. The cell now consists of two unequal parts, the smaller one,

the daughter-cell, eventually separating from the larger one, the mother cell. This separation may not occur until after the daughter-cell or "bud" has begun to produce daughter-cells itself. The connection between the mother and daughter cells may persist for several generations if the yeast be growing actively. Size? S. cerivisiæ 6-8 microns in diameter, 5-11 long. S. pastorianus 7 8 microns in diameter.

Another method of reproduction is possessed by yeast: that of endogenous division or formation of ascospores. Under certain conditions the protoplasm within the cells divides into two, three, or four rounded bodies, that become surrounded by a cell-wall, thus giving rise to a number of cells within the original cell; this latter is called an ascus, the contained cells, ascospores.

In brewing there are two varieties of yeast employed which produce charcteristically different fermentations, and are known as top and bottom yeasts. The top yeast works at a comparatively high temperature; the action is rapid, and the yeast is at the surface of the liquid. This top yeast is used in the brewing of ale and porter. The bottom yeast works at low temperature, the action is slow, and the yeast is at the bottom of the liquid. The bottom yeast is used in the brewing of lager beer.

There are also what are known as "wild" yeasts in distinction from those that are cultivated. To the wild yeasts are due the fermenting of fruit juices; as, grape and and apple. Sweet cider will always show, under the microscope, one of these characteristic forms. The yeast is found on the skin of various fruits, and on the ground under the trees; from here it can be carried as a fine dust by the wind. It is supposed that the cultivated varieties of yeasts originated from these wild forms, though notwithstanding their frequency, I have never been able to get one from flour, but have gotten the hay bacillus, B. subtilis, in large quantities.

There are three periods in the study of fermentation. The first was based upon the question as to the coming into existence of micro-organisms by spontaneous generation. From this followed the method of sterilization. The next was the Pasteur period, in which Pasteur proved that bacteria exert a great influence in fermentation, usually a bad one. The third period may be called the Hansen period, which is certainly as epoch-making as that of Pasteur, for Hansen has proved that the diseases of beer are caused mainly, not by bacteria, but by yeast itself. He it was who devised a method for cultivating pure yeast, obtaining his cultures from a single cell. This makes it possible to separate from one another the different species of yeast. This has been of immense value in the brewing industries, for varieties have been studied, and those possessing certain desirable properties selected for use; besides, a brewing started, absolute certainty could be felt as to the result, and that result duplicated at any time. Yet, in bread-making, similar problems present themselves to those of brewing:—To determine which form of yeast will give desirable results as regards taste, lightness, duration of fermentation, and keeping properties. At the present time, one gets yeasts in the market under various names, without knowing just exactly what properties will be given by the yeast selected, and whether the results can be duplicated. Then one gets sour bread occasionally without any apparent reason following from the making.

Of course, the souring is due to the fact that the yeast was not pure, it containing in many cases different kinds of yeast as well as moulds and bacteria. The form most probably causing the souring is B. aceti, a bacterium that attacks acid solutions, containing a small amount of alcohol. The dough furnishes a good nidus for its growth after the alcoholic fermentation has taken place. There

are various other products formed by the bacteria and moulds that are present.

I have been making some experiments on bread, using pure cultures of yeast. Three different yeasts were used; one separated from a compressed cake, another from a dry cake, while the third was obtained from what is known as potato yeast, i. e., a culture of brewers' yeast in an impure condition in potato solution. The form occurring in greatest abundance in the cakes and solution respectively being the ones used.

Control experiments were carried on at the same time, using ordinary compressed yeast. Best results were obtained from the pure yeast gotten from the compressed cake. The time and extent of fermentation were about the same as that obtained in the control, but the somewhat sour odor one gets in ordinary dough was lacking, and the bread was sweet to the taste.

Some of the dough was kept, that of the control souring the second day, whereas the pure culture gave no indication of souring at the end of two weeks.

The results of the experiments are not so decisive as they are suggestive of the possibilities for pure yeasts in bread-making. A sufficient number of yeasts were not used to determine the qualities which they would give to bread, but sufficient was done to prove that the bread from the pure culture was superior in many respects to that from the impure yeast cake.

In brewing, pure yeasts have been used, and that with the most advantageous results; to such an extent is this true that Hansen's pure and selected races of yeast are used in breweries in America, Europe, Asia, and Australia. Apparatus has been devised by means of which yeast can be transported to any part of the world in a pure condition, and also appartus for cultivating large qnantities of the yeast for pitching purposes. And, as it has been determined that under brewery conditions, constancy of

characters undergoes but slight changes, why could not the same points be made use of in selecting yeasts for baking purposes?

Besides, looking at it from the point of view of the makers of pressed yeast, a better yield of yeast should result from a careful selection of a cultivated species. Moreover, when people in general understand the action of yeast and fermentation as a whole, better, the prejudices held by some people against yeast will be abolished, and the sensational "scares" that appear occasionally in the newspapers will cease, as will also the pseudo-scientific communications such as those published in the "Century" a year or so ago from a well-known physician connected with the New York Board of Health.

QUESTIONS ANSWERED.

Note.—*Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of all grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.*

234 *How shall I make hay or vegetable infusion, for animalcules, etc? E. W. P.*

Cut some hay or other vegetable matter into small fragments, cover it with tepid water and let it stand in a warm place for two or three days. Water that has contained cut flowers, is teeming with infusoria, especially if at all putrid.

235 *Can you inform me who is the successor of professor H. L. Smith, the Diatomist? D. A. N.*

Dr. D. B. Ward, 27 Garden Street, Pougkeepsie, N. Y. has all the diatom material collected by Prof. H. L Smith.

236 *Kindly inform me of the most recent work on preparing and mounting, containing specific and detailed methods, general information, etc.—in one volume or single. C. M. M.*

Practical methods in microscopy—by Chas. H. Clark.—Pub. D. C. Heath & Co.

PRACTICAL SUGGESTIONS.

By L. A. WILLSON,
CLEVELAND, OHIO.

Magnification.—"How much does that instrument magnify?"

Every possessor of a microscope has frequently been obliged to answer this question. In court the same question is generally propounded to the microscopical expert. There is a popular fallacy that the value of a microscope depends on the amount of its magnification. The novice at the microscope is often compelled to gradually recover from this diseased notion. After being entertained by a beautiful microscopical exhibit a neophyte will proceed to a dealer and purchase the best microscope and the highest lenses that money will procure. Those that do so soon consign the instrument to the garret and abandon the pursuit in disgust. We must creep before we can walk. We must begin at the lowest rung of the ladder and ascend. Besides the greater number of the most beautiful and instructive objects are to be seen with objectives no higher than an inch and a quarter inch objective.

Never use a higher power than will clearly show the specimen under examination.

For seeing nine-tenths of the objects for which the microscope is used by an amateur high powers are absolutely useless.

In union there is strength:—Every amateur should if possible find an associate to work with and if possible join a microscopical society. More can be learned in one evening in a society than can be acquired by months of toil. Even two novices by correcting each others errors and by a mutua interchange of ideas can greatly facilitate progress. Working alone is up-hill business and often when passing from seclusion to the open society of the world of micrscopists the solitary worker will find that he has entertained many errors which it will require time to eradicate. Of two amateurs, the union of a scientific worker with a non scientific worker of a mechanical turn of mind will generally be found mutually advantageous.

The Microscope in Chemistry.—The value of micro-chemical analysis, and the simplicity of its processes, commend this department of microscopy to general favor.

A large proportion of the actions and changes produced by reagents may be observed as satisfactorily in drops as in larger quantities.

Great care should be observed when examining chemicals with the microscope. An objective with a gold front will be found servicable.

Some Points on Crystal Slides.—The methods of producing these slides should be varied with the different substances and the different effects desired.

Sulphate of iron dried on a slide will produce arborescent and fern-like crystals but if stirred with a glass rod or needle while evaporating will form separate rhombic prisms.

Pyrogallic acid crystallizes in long needles, but a little dust as a nucleus brings about a change of arrangement resembling the "eye" of a peacock's tail.

A saturated solution dropped into alcohol, if the salt is insoluble in alcohol, will produce instantaneous crystals. Some substances as salicin will produce bests results by being fused in a slide over a lamp and spread evenly. This may be done with a hot needle.

SCIENCE-GOSSIP.

The Micro-organism of Measles.—Joseph Czajkowski (Centralbl. fur Bakt. und Parasit., 1895, No. 17–18, p. 511) contributes a further addition to our knowedge of the bacillus which he previously described as existing in the blood in measles. The bacilli in the blood vary in length from one-half micromillimeter to the diameter of a red blood-corpuscle, and in cultures grow into long threads. They stain well with all the anilin dyes, and in the longer forms a part of the protoplasm often remains unstained. They loose their stain by Gram's method.

They grow best in bullion or sterile serous fluid from the abdominal cavity, in which a whittish, fairly heavy sediment is formed, which in older cultures becomes yellowish-gray. The cultures have no characteristic odor. Rabbits were always immune to the bacteria. Mice died from septicemia three to four days after inoculation with small quantities of the culture, the bacilli being obtained again in pure cultures from the liver and spleen.

The author believes the bacillus described by him to be the specific cause of the measles.—*Medicine.*

RECENT PUBLICATIONS.

Lessons in Elementary Botany for Secondary Schools. —Thomas H. Macbride. Boston,Allyn and Bacon, 1896 pp. 233.

Elements of Botany.— J. Y. Bergen, Boston, U. S. A. and London. Ginn & Co., Part. I., pp. 275 and viii. pt. II. pp. 57.

If one can judge from the number of text books on botany issued during the last few years in this country, the study must have a larger share of attention in our high schoo's and colleges than formerly. Two small books have recently appeared, both from teachers of experience. Prof. Macbride's book is divided up into fifty-four lessons, beginning with buds and their arrangements, stem arrangements, structure and kinds, roots, leaves, infloresence, flowers, fruit and seed, then special plants, such as wake-robin, maple, buttercups and wind flowers, dandelions, rye, blue grass, ferns, mosses, fungi, and an outline of the vegetable kingdom. The book as the author says cannot be used by the teacher unless he is equipped with a good general knowledge of botany and the flora of his own immediate locality. Prof. Macbride has adopted the plan that pupils should be directed to study plants rather than the book. Admirable indeed, in fact no one should use any of the numerous text books without the plants to illustrate structure. He insists too that drawings should be made. We commend the suggestion that "these drawings however, should not be permitted to supplant full and accurate descriptions of the material studied, inasmuch as the development of ability to describe accurately is one object to be kept

in view." A student taking a course in this work, under the guidance of a good teacher ought to have a fair knowledge of pollination, the structure and relationships of plants. The numerous questions asked ought to make the student think rather than take statements for granted. It ought certainly to train the student's power of observation, and this after all, for most students, is the most valuable part in a study of natural history.

The Bergen book begins with seed and germination, parts of a seedling, storage of nourishment in the seed, roots, stem, structure of stem, buds, leaves, leaf arrangements, minute structure of leaves and functions, protoplasm and its properties, infloresence, and plan structure of the flower, nature of floral organs, fertilization, fruit, struggle for existence, classification of plants and types of flower plants.

The work is admirably planned. The work outlined consists of experiments as well as giving reasons for observed phenomena.

Under seed and its germination, squash seed is first taken up with reference to germination, then an examination of general character. In experiment (1), emphasis is laid on whether light assists germination or retards it; in experiment (2), temperature is considered; in experiment (3) relation of water to germination; in experiment (4) relation of air to germination.

The work combines histology, physiology and morphology. The chapter on flowers takes up pollination. We believe however that the author should have used the word pollination in place of insect fertilization, and wind fertilization. The chapter on fruits discusses dissemination with pertinent questions as to why and how plants are disseminated. We hope when a second edition is called for, that the author will place the index and glossary at the end of the volume. As it is the index and glossary of part I immediately precede part II. There can be little use for part II, Key and Flora, which only embraces a few of the commonest spring flowers of the northern and middle states. There partial floras are always unsatisfactory as one is sure to find, in a short time, plants that are not represented. The book is however a commendable one in other respects and will prove valuable for high schools and smaller colleges.

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THE MICROSCOPE

APRIL, 1896.

NUMBER 40 NEW SERIES.

Formalin as a Hardening Agent for Nerve Tissues.

WILLIAM C. KRAUSS, M. D.,

BUFFALO, N. Y.

[Member of the American Microscopical Society.]

Formol, Formalin, or Formaldehyde was discovered by A. W. Hoffman in 1863 while passing wood spirit and air over a red-hot platinum spiral. If the vapor is brought into water to its point of saturation, a forty per cent solution of formaldehyde is obtained, which has long been known under the name of formol. That Formalin possessed antiseptic as well as hardening powers we owe to the investigations of Dr. F. Blum, and these facts induced the elder Blum to make an extended series of investigations in the hardening of animal and vegetable tissues in the Senckenbergischen Institute at Frankfort, Germany. His preliminary report was published in the Zoologischer Anzeiger, 1893, No. 434, and a more detailed report in the Berichte über die Senckenbergische Naturforscher Gesellschaft, 1894, p. 195. Here he details his experience, which in brief is as follows: Several human embryos were finely preserved in formol diluted with ten to twenty parts of water. Small embyos with amnion intact were preserved and the amniotic fluid remained transparent, so that the structural parts of the fœtus and the umbilical cord were recognizable. The mouse, hamster, and porpoise, were nicely preserved, the hair firmly in

place and the eyes in better condition than under the use of alcohol. Reptiles, fishes and amphibians were nicely hardened in one to ten, one to twenty, or one to thirty, solutions according to the size of the object. The fishes retained in great part their color, while the slime and mucus covering them was rendered transparent. Of the invertebrates, snails, jelly fishes, insects, spiders, etc., all were well preserved.

Of the various animal tissues, muscles and the brain were quickly hardened, retaining the coloring matter of the blood in the muscles, while in the brain the differentiation between the white and gray matter was very evident. Fruits, flowers and vegetables of various kinds were equally successfully preserved, the coloring matter very little if at all impaired. Blum's conclusions regard- the hardening of animal tissues may be summed up as follows:

Animal objects are hardened with shrinking, and without losing their microscopic structure or staining properties.

The natural form and color are preserved.

The eye remains much clearer than in alcohol.

The mucus of slime-producing animals is not coagulated and remains transparent.

The coloring matter of blood in tissues apparently disappeared, but may be quickly restored by a high per cent alcohol.

These experiments of Blum were pathmaking and were quickly followed by those of Born, Pintner, Kruckmann, Kenyon, Sadebeck, Mayers, and others with seemingly favorable results as regards the preserving and hardening powers of this compound. Besides these qualities it was especially valuable because of its being non-poisonous, non-combustible, of a low freezing point, and, what to scientists is quite a serious question, very cheap.

My attention was directed to this substance about one year ago, through experiments made at the Laboratory of the Erie County Hospital by my interne, Dr. Helvic.

Various tissues, as liver, spleen, placenta, lungs, heart, muscles, and other tissues and organs were satisfactorily hardened and preserved. Especially gratifying were the results obtained with the umbilical cord, and other myxomatous tissues. Instead of shrivelling up and becoming opaque as occurs when alcohol is employed, the cord retained its normal size, was transparent and hardened to such a degree that sections were easily and perfectly cut with microtome. The intestines were greatly shrivelled during hardening, but otherwise were a success.

These results induced me to try its virtues upon the brain and spinal cord, and especially to find the earliest time when a spinal cord so hardened could be imbedded in celloidin and sections cut for staining and mounting. A spinal cord which to all appearance was normal was cut in pieces about one centimeter long and placed, sections of the cervical, thoracic and lumbar regions in bottles containing a five per cent solution, ten per cent, twenty per cent and twenty-five per cent of Formalin. At the end of seven days a section of the cord was taken from each of these solutions and imbedded in celloidin, then placed on the microtome. The cord was evidently too imperfectly hardened, as no good cuts were obtained. At the end of fourteen days the same procedure was followed, likewise on the twenty-first day and twenty-eighth days. From each of these intervals excellent cuts were obtained; the cord retained its external contour and appearance, but the differentiation between the white and the gray matter was not as well marked as when alcohol is used. These sections took the carmine stains nicely, but less so the nigrosin, Pal and Weigert stains. The most serious action of the formalin on all of these sec-

tions was a contraction, evidently of the neuroglia in various regions of the cord, especially of the white matter resulting in the formation of open spaces or cavities. In the sections hardened in the 10 per cent solution these cavities were so large as to destroy completely the slides for microscopical purposes. In the 15 per cent cord, the cavities were much smaller, but far more numerous, and the dorsal white columns looked like a honey comb or sieve. This action of the formalin was manifested in every section examined and is therefore not of accidental, but of regular occurrence. The drawback of the formalin in preventing the employment of the Pal and Weigert methods of staining has been successfully overcome by Marcus, who after hardening the cord for from two to four weeks in a one-half per cent solution of Formalin, places small portions one-half cm. thick in Muller's fluid in a brood oven for seven days at a temterature of 37° C. They are then dehydrated, imbedded, and the cuts again placed in Muller's fluid, for from two to seven days in a brood oven, quickly washed in alcohol then transferred into the Weigert stain.

The action of the formalin on the ganglion cells is a happy one, swelling them and rendering their nuclei susceptible to very intense staining.

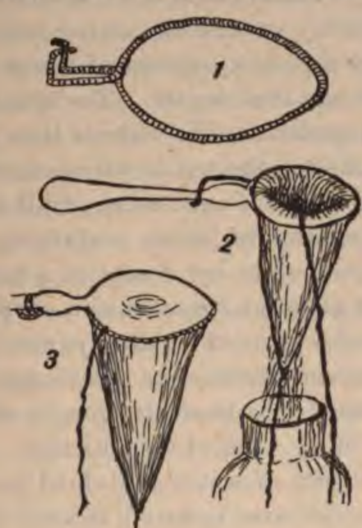
The action of formalin on the brain has given very fine results. Born succeeded in hardening the entire brain very quickly for demonstrations, also small particles for microscopical purposes. I have been equally successful and have some excellent specimens, nicely hardened. I have not as yet tried any of the staining methods on brains thus hardened and cannot state what the results would be, although I have some specimens under way. From my experience with Formalin I can greatly recommend it, for the hardening of the various organs and tissues for macroscopic as well as microscopic purposes, but would still cling to the Muller's solution

for hardening the spinal cord, even if the time required for hardening be much longer than when Formalin is used.

Simple Apparatus for Gathering Microscopic Objects.

BY G. M. HOPKINS.

One of the difficulties experienced by a beginner in microscopy is the finding and gathering of objects for examination. As a rule, cumbersome apparatus has been used. The conventional apparatus consist of a staff, to which are added a knife, a spoon, a hook and a net; but a



great deal can be accomplished with far less apparatus than this.

The engravings illustrate a simple device, by means of which the amateur microscopist can supply himself with as much material as may be required. It consists of an ordinary tea or desert spoon, and a wire loop of suitable size, to extend around the bowl of the spoon, having the

ends of the wires bent at right angles, and in opposite directions. To the loop is fitted a conical cheese-cloth bag, and to the bottom of the bag, upon the outside, is attached a strong string, which extends over the top and down to the bottom in the inside, where it is again fastened. The spoon is inserted between the bent end of the loop and turned, and the point of the bowl is slipped through the loop.

The instrument is used in the manner shown in Fig. 85, that is to say: it is scraped along the surface of objects submerged in the water, the water passing through the cloth, and the objects being retained by the conical bag. When a quantity of material has accumulated, the bag is turned inside out by pulling the string, and the pointed end of the bag is dipped a number of times in water contained in a wide-mouthed bottle. The operation of collecting is then repeated. The objects thus washed from the bag are retained in the bottle for examination.

The common method of examining small objects of this kind is to place a drop of water containing some of the objects upon a glass slide by means of a drop-tube, then to apply a cover-glass, and remove the surplus water by the application of a piece of blotting paper. This answers very well for the smaller objects, but larger ones must be examined in a tank or animalculæ trough, which may be obtained at a trifling cost of all opticians. To vary the thickness of the body of water contained in the tank, one or more glass slips are inserted behind the objects.—*Scientific American.*

Evils of the Microscope.—"Johnnie, here you are at breakfast with your face and hands unwashed!"

"I know, mamma, I saw the little things that live in water through papa's little microscope last evening and I'm not going to have them crawlin' over my face with their funny little legs."—*Demorest's Magazine.*

Mounting in Phosphorus, Etc.

BY ARTHUR M. EDWARDS, M. D.

NEWARK, N. J.

Ever since I began to use Gum Thus for mounting microscopic specimens, and the mounting is easy now, doing away entirely with the sticky Canada Balsam, which has not the refractive index of Gum Thus, I have been after some mode of putting up the various specimens I have in solid bodies. Lead chromate has a refractive index of 2.50 to 2.97. It is therefore the best object we have for microscopic specimens. Phosphorus has an index of 2.224 and comes near to lead chromate.

I have succeeded in preparing both of these, and will detail exactly how I make them. Premising that the preparations are not patented and can therefore be made by anyone, and I wish they would be made and reported on, for I feel that we have here a means of mounting easy and cleanly and goodly therefore, for the refractive index is high and bacillariaceæ, for instance, show nicely when it is used. Any kind of object shows well and we have a medium here attached to the modern immersion objective of oil of cedar, chromate of lead first. I first prepare the solution of Gum Thus in alcohol. Gum Thus is common and sells at about five cents a pound. A lot, about a half a pound, is placed in a wide mouthed bottle and alcohol, the common spirit, is poured on it. It is left to dissolve, being shaken from time to time. I find placing it in the sun in warm weather or otherwise heating it will hasten the solution, after a day or so a saturated solution of Gum Thus in alcohol is obtained. It is labeled and put aside to clear by deposition. This it does in two or three days.

Lead chromate is made by acting of solution of lead acetate (sugar of lead) by means of potassium bichromate and the yellow precipitate washed until all of the

potassium acetate is removed, the yellow lead chromate washed on a filter. It is drained until it is a moist powder, not dry, and then is added to the Gum Thus solution in alcohol, in excess, and boiled by means of a water bath for about fifteen minutes. The solution is left to stand until cool and the excess of lead chromate permitted to settle. We have then the mounting material.

Preparing the phosphorus solution for mounting is done in a different way. Procure some pure phosphorus. Remember that it is inflamable, and, besides, the burns that it makes are extremely painful. It is also poisonous, so to prepare it we work with it under water handled with a forceps, not by the hand at all. Some is put into a flask and cold water added. It is then held over the flame of a lamp until the phosphorus melts. Immediately it is taken from the flame and violently shaken. At the same time cold water is added. In this way the phosphorus is broken up and concretes into fine sand-like phosphorus in particle of the sand being spherical. When it is cold, a few grains of the sand are collected by a pipette and transferred to another vessel. Here the water is nearly poured off and oil of cinnamon added in enough quantity to just cover the phosphorus. It is then heated, not boiled, and some of the phosphorus dissolves. It is then added to the solution of Gum Thus in alcohol and we have the solution of phosphorus for mounting.

Sulphur can be dissolved in the same way and quinidine also. All of these make valuable mounting solutions and I hope for their introduction into microscopy, for I feel that we have here solutions of interest and shall look for the results with interest.

Louis Agassiz.—Another biography, of 620 pages, has been issued to record the life of this naturalist. This time Mr. Jules Marcou is the biographer who says that the previous lives were too eulogistic. The review of this book by *Nature*, however, is far from eulogistic of what Marcou has written. It is very spicy.

THE MICROSCOPE.

New Series, 1893.

For Naturalists, Physicians, and Druggists, and Designed to Popularize Microscopy.

Published monthly. Price $1.00 per annum. Subscriptions should end with the year. The old series, consisting of 12 volumes (1881–1892), ended with December, 1892 Sets of the old series cannot be furnished. All correspondence, exchanges, and books for notice should be addressed to the Microscopical Publishing Co., Washington, D. C., U. S. A.

CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

Preservation of Yeasts.—Hanson carries out this in using 10 per cent solutions of sugar-cane. Stock yeasts may be kept for many years without suffering any detriment. They can be propagated in beer wort and transported at pleasure. Hanson and others have sent yeasts from Copenhagen to South America, Australia and Asia in perfect condition. Those interested should get from London the English translation of Hanson's "Practical Studies in Fermentation; being contributions to the Life-history of Micro-organisms."

Sodium Fluoride as an Antiseptic.—Sodium fluoride, flurol, is said to be a valuable antiseptic, and it is a bluish-white odorless powder of saline taste. It is said to be preferable to corrosive sublimate, which is sixteen times more poisonous, and preferable to nitrate of silver, formaline and permanganate In 1 per cent or even in half per cent solutions it acts as a powerful germicide. One of the objections to the use of corrosive sublimate is that the albumenoids are coagulated and bacteria are protected by an envelope of coagulated albumen. This is not the case with sodium fluoride.

QUESTIONS ANSWERED.

NOTE.—*Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of all grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.*

Does the binocular microscope excel the monocular form in ease of vision or clearer image? Would a binocular stand at **$90.00** *or* $98.00, *be too cheap to give satisfaction?* — *E. N. H.*

The binocular microscope is inferior to the monocular form for ease of vision and for clear images. The single image formed by the single objective is divided by the binocular prism, with a loss of light and of definition. Course objects, like sand or shells, stand out in pretty, stereoscopic relief but, good definition requires a clear, straight tube, which can be had in the binocular form by sliding back the prism in the nose piece or bottom of the tube. A binocular stand at $90.00 ought to be satisfactory.

PRACTICAL SUGGESTIONS.

BY L. A. WILLSON,

CLEVELAND, OHIO.

How to See Trichina in Raw Pork.—We have often, in these pages suggested that the microscope, as its name implies, is for the observation of little things. A few evenings since, an amateur brought a piece of trichinous pork which he had placed on a glass slip and covered. He had placed a comparatively small piece on the slide. The trichinæ were visible but were dim and hazy. Upon lifting the cover, and picking out a piece of a single muscular fibre, removing the rest of the meat; covering the particle of single fibre, and pressing it out thin with the finger on the cover, the trichinæ in their cysts were plainly, clearly, and beautifully visible. Examined with a quarter-inch objective they were still plain, and all the details of the parasite could be plainly and satisfactorily observed.

The Prothallium of a Fern.—It is very interesting to view a prothallium of a fern. They may be found at the base of the plants and may be esily obtained in a green-house where ferns are cultivated. They are small, heart-shaped bodies and are interesting as they contain the archegonia and antheridia which will eventually produce a new fern. The antheridia project from the basal portion of the under surface of the prothalium. One of the interior cells becomes divided into sperm-cells, in each of which is a specially coiled spermatozoid. The archegonia are cellular projections from the anterior portion of the under surface of the prothallium. These prothallia may be dried and mounted in balsam.

Eosin Staining.—Dilute solutions of eosin, one part to one thousand of water, may be used for animal tissues. The different parts are differentiated by different tints. Sections are stained in a minute and a half. Then wash it in water acidulated slightly with acetic acid, and examine in glycerine ; or, mount in balsam after the water is removed and the section is thoroughly dried.

Identification of Lichens by Measuring Spores.—Many species of lichens are outwardly very similar but may be indentified by the difference in the size of their spores. Nearly all works on lichens give the sizes of the largest and smallest spores. The identification may be determined by a measurement of the spores. This is not difficult. The microscope should be provided with an eye-piece micrometer. Then let a stage-micrometer, divided by thousandths of a millimetre, be placed on the stage of the instrument and let the observer note how many of its divisions are equal to one division of the eye-piece micrometer. By this method the spores can subsequently be measured by the use of the eye-piece micrometer.

Microscopical Examination of Sputum for January.—Number of examinations made in the Battle Creek Sanitarium, 36; number of cases, 29; number of specimens in which tubercule bacilli were found, 14.

Patients whose sputum contained tubercular germs, were received from the following states; Michigan, 9; Texas, 1; Colorado 1; Iowa, 1; Mississippi, 1; Ontario, 1. Total. 14.

SCIENCE-GOSSIP.

Commercial Use of Red Pigment From Bacteria.—It is a well known fact that many bacteria produce beautiful pigments. The Chinese have long used a pigment, "Aug-Khak," for the coloring of foods. The microbe producing this color grows readily on all starch-containing substances. The rice is grounded and boiled and inoculated from an older culture. In about six days an abundance of the coloring matter is produced. The organism only grows in the presence of air and in a cool damp place. To check the growth of deleterious species arsenic is added, which does not influence the pigment form.

Micro-Organisms on Coins.—The *Revue d'Hygiene* publishes an interesting account of some experiments made at the bacteriological laboratory of the Military Hospital of the Dey at Algiers. Dr. H. Vincent explains that money is specially liable to be contaminated by saliva, pus, pathological secretions, dust, and the morbid germs that may be found in dirty pockets or on dirty fingers. He does not think, however, that evidence of this danger can be easily obtained by placing dirty coins in culture broth. The investigations at the Dey Hospital were conducted in a different manner. A piece of cotton-wool about the size of a pea was dipped in water and sterilized. Pieces of wool thus prepared were seized with pincers that had been held in a flame and were gently passed over the coin to be examined. The pieces of wool were then placed in culture broths and kept in a temperature of 35° C. The product, which soon contained various micro-organisms, was sown anew in gelatine plaques so as to isolate the bacteria. In other cases it was inoculated in doses varying from one to five cubic centimeters, in the blood or under the skin of rabbits, guinea-pigs and white rats. A lengthy description of the methods employed and the results obtained is given. The number of bacteria found on the surface of coins varied very considerably, on silver and gold from four hundred and sixty to thirty-five hundred, and on copper a still larger number. To destroy many of the non-pathogenic microbes some experiments were made at a temperature of 37° C. The injection of mixed cultures from coins only produced

death or serious results in about one out of every ten inoculations. Death was sometimes rapid, with symptoms of acute septicemia. In one case tuberculosis was communicated to a rabbit by a piece of wool which had been passed over a ten-centime copper coin. In another case there was slight tetanus. There can be no doubt that germs of disease are often to be found on the surface of coins, notably the microbe of suppuration, the staphylococcus pyogenes, and the streptococcus. Nevertheless, as the experiments were repeated they proved that there were fewer infectious germs than had been anticipated.

Another series of experiments was then made which demonstrated that, though coins are often contaminated they possess in themselves antiseptic qualities which greatly reduce the risk. If pathogenic germs are placed on coins it is seen that they do not live long. The time varies according to the temperature and the nature of the metal. In a cold temperature the germs of typhoid fever and the Friedlander bacillus are killed in eighteen hours if placed on a sterilized copper or silver coin; and the pyocyanic bacillus and that of green diarrhœa in twenty-four hours. At a temperature of a pocket, about 36° C., the bacilli of typhoid fever, of blue pus, of diphtheria, and the streptococcus are destroyed in less than six hours. The bacilli of diphtheria are among the most tenacious, and in cold will live three days on silver and six days on bronze. Gold, of course, is less antiseptic, and the Eberth bacillus will live five days and that of diphtheria six days on a gold coin in a temperature of 20° C. at a damp temperature of 36° C., the destruction of the microbes is very rapid, and that is the temperature which often prevails in the pockets of clothes.—*Medical Record.*

Bacteria in Railroad Cars.—An examination of the dust of railroad cars made in Germany under the direction of the Imperial Board of Health, showed in fourth-class cars more than twelve thousand germs per meter, than in first-class cars about one-fifth this number. Some of the animals inoculated with the dust died of tuberculosis, showing the presence of this germ with the other miscellaneous microbes, of which railroad carriages, as at present managed, furnish a very large assortment.—*Modern Medicine.*

CORRESPONDENCE.

The articles in the MICROSCOPE by Chrysanthemum are just right and I hope that they will be continued through 1896.—O. E. S.—Port Townsend, Wash.

Buffalo, N. Y., March 31, 1896.

To the Members of the American Microscopical Society:

The next meeting of the Society will be held at Pittsburg, Pa., August 18, 19, 20, 1896. Our Society will be the first National Society to meet in the beautiful new Carnegie Library Building and will therefore have an additional honor bestowed upon it. The Iron City Microscopical Club is putting forth every energy to make the '96 meeting the banner meeting of the Society, and to succeed, needs the support and encouragement of every member.

We ask you, therefore, to do your share: Come to the meeting prepared to read, discuss or listen. You have at least one friend interested in Microscopy, who can be persuaded upon to join. Fill in the blanks and send them to the Secretary as soon

as possible. Mr. C. W. Smiley, 943 Massachusetts Avenue Washington, D. C., will send blanks for application.

A preliminary program will be published on July 15, 1896, and if you have anything interesting or new, communicate it to

the Society, and let others have the benefit of your work, thus showing the true scientific spirit.

WM. C. KRAUSS, M. D.,
382 Virginia Street. Secretary.

Gents:

I have the pleasure to send you by express a cut of the famed Carnegie Library Building, where the next meeting August 18-20 is to be held.

The local committee is organized: C. C. Mellor, Chairman, Magnus Pflaum, Secretary and Treasurer, and C. G. Milnor, Chairman, Finance Committee, either of them will be glad to give members 'and others desiring to attend, all necessary information. As soon as sufficient arrangements are made, special announcement will be mailed to all members.

Yours truly,

MAGNUS PFLAUM.

RECENT PUBLICATIONS.

New Truths in Ophthalmology as developed by G. C. Savage, M. D., third edition. 12° square. 270 pp. 58 illustrations.

This enlarged edition appears to have been necessitated by the criticisms of Eaton, Hotz and Wilson, to meet those strictures. Three new chapters have been added. Dr. Savage thanks his critics for having in their own way aided him in presenting more clearly his views on oblique astigmat.sm and the oblique muscles.

There is a new chapter on treatment of insufficiency of the obliques. The development of weak ciliary muscles and the prevention of presbyopia receive generous consideration.

Dr. Savage is taking front rank among the opthalmologists of the day and as a writer on the subject. Everyone who treats eyes ought to know something which he can tell and the book should be a text-book in college classes studying the eye.

Our notice must be brief because microscopy is not involved in his theme but we cordially commend the book to those who are interested in the technique of the subject.

THE MICROSCOPE.

Contents for April, 1896.

THE MICROSCOPICAL JOURNAL.

Contents for April, 1896.

THE MICROSCOPE

MAY, 1896.

NUMBER 41 NEW SERIES

Sabella.

BY P. H. GOSSE, F. R. S.

For some time I have been keeping in a tank a specimen of that rather rare and very interesting Sabella, the Amphitrite vesiculosa of Montagu. It is a worm inhabiting a sort of skinny tube, much begrimmed with mud, about two inches of its length being exposed, and about as much more concealed in the sand and sediment.

A beautiful object is presented by the gill-fans of this worm. These organs are alway elegant, whatever species

The Witches' Dance Around the Charmed Pot.

we may have before us, but here, in addition to the slender filaments, so delicately fringed, with their double comb-like rows of cirri, the tip of each bears a dark purple spherule. That of the anterior filament on each side is much larger than the rest, andforms a stout, globose, nearly black ball; the others diminish to about the

twelfth on each side, where they disappear. These balls are placed on the inner or upper face of the filament-stem, at the point where the pectination ceases, the stem itself being continued to a slender point beyond it, and constituting the "short hyaline appendage" of Montagu. From their great resemblance to the tentacle-eyes of the Gasteropod Mollusca, I have little doubt that these are organs of vision. If so the profusion with which the Sabella is furnished in this respect may account for its excessive vigilance; which is so great, that not only will the intervention of any substance between it and the light cause it to retire, but very frequently it will dart back into its tube almost as soon as I enter the room, even while I am ten feet distant.

It is not, however, to the tube nor to the worm, that I wish especially to direct the attention: yet it is necessary that I say a preliminary word about the former. Ordinarily the tubes of these worms are formed of the fine impalpable earthy matters (clay, mud, etc.) held in suspension in the sea, incorporated with a chitinous secretion from the body of the animal; and therefore the surface of the tube is always rough and opaque. But in this individual case, probably owing to the habitual stillness of the water in the vessel not holding in suspension the particles of mud that ordinarily enter into the composition of the tube, the latest-formed portion is composed of pure transparent chitine, without any perceptible earthy element. This clear terminal portion of the tube you may perceive to be occupied by a curious parasite. About twenty bodies, having a most ludicrously close resemblance to the human figure, and as closely imitating certain human motions, are seen standing erect around the mouth of the tube, now that the Sabella has retired into the interior, and they are incessantly bowing and tossing their arms in the most energetic manner.

As soon as you have recovered from your surprise at this strange display, we will begin to examine the performers more in detail. A slender creeping thread, irregularly crossing and anastomosing, so as to form a loose network of about three meshes in width, surrounds the margin of the sabella's tube, adhering firmly to its exterior surface, in the chitinous substance in which it seems imbedded. Here and there free buds are given off, especially from the lower edge; while from the upper threads spring the strange forms that have attracted our notice These are spindle-shaped bodies, about one-fortieth of an inch in height, whose lower extremities are of no greater thickness than the thread from which they spring; with a head-like lobe at the summit, separated from the body by a constriction, immediately below which two lengthened arms project in a direction toward the axis of the tube.

Such is the external form of these animals, and their movements are still more extraordinary. The head-lobe of each one moves to and fro freely on the neck, the body swags from side to side, but still more vigorously backward and forward, frequently bending into an arch in either direction; while the long arms are widely expanded, tossed wildly upward, and then waved downward, as if to mimic the actions of the most tumultous human passion.

Whenever the Sabella protrudes from its tube, these guardian forms are pushed out, and remain nearly in contact with the Annelid's body, moving but slightly; but no sooner does it retire than they begin instantly to bow forward and gesticulate as before. These movements are continued, so far asI have observed, all the time that the Sabella is retracted, and are not in any degree dependent on currents in the surrounding water, whether those currents be produced by the action of the Annelid

or by other causes. They are not rhythmical; each individual appears to be animated by a distinct volition.

Applying a higher magnifying power than we have yet use to these animals, we find that the head-lobe encloses a central cavity; that the arms are also hollow, with thich walls, marked with transverse lines, indicating flattened cells, and muricated on the exterior; and that the body contains an undefined, sub-opaque nucleus, doubtless a stomachal cavity.

I cut out, with fine scissors, a segment of the tube, including two of the parasites, with the portion of the network of threads that carried them. They have become immediately paralysed by the division of the threads, but those that remain on the tube are unaffected by the violence. Subjecting one of the animals so cut out to the action of the compressorium, with a power of 560 diameters, the arms are seen to be formed of globose cells, made slightly polyhedral by mutual pressure, set in single series.

The interior of these organs is divided by partitions, placed at intervals of about the diameter. Some at least of the cells contain a bright excentric nucleus.

When the tissues were quite crushed down by the pressure of the compressorium, a quivering motion was visible among the disjointed granules, but it was very slight. No trace of cilia, nor any appearance of cilliary motion was perceptible during life.

When I first discovered the strange beings, I was much astonished by what I saw; nor could I imagine to what class of animals they were to be referred. Neither did I know whether their presence on the tube of the worm was a mere accident, or whether it indicated a predominal instinct. On both these points, however, light has been thrown.

This larger Sabella tube was not the only one infested with the parasites. I observed them on at least two

smaller specimens of the same species, in the same situation, and with the same movements. The extremity of one of these smaller tubes I cut wholly off, and placed in the live-box of the microscope. Two of the parasites only were on it, which were active at first, but in about an hour—probably from the exhaustion of the oxygen in the small quantity of water inclosed—they decomposed, or rather disintegrated, the outline dissolving, and the external cells becoming loose and ragged, the whole animal losing its definite form.

One of these specimens, however, while yet alive and active afforded me an observation of value. I had already associated the form with the Hydroid Polypes, and was inclined to place it in the family Corynidæ, considering the arms to be tentacles, and the head lobe to be homolowith them in character, but abnormal in form. It appeared to be a three-tentacled Coryne, with the tentacles simple instead of capitate. But while I was observing it, I saw it suddenly open the head-lobe, and unfold it into the form of a broad shovel-shaped expanded disk, not however flat, but with two halves inclining towards each other, like two leaves of a half-opened book. This reminded me of the great sucking-disk of Stauridia producta, and confirmed my suggestion of the natural affinities of the form.

Formalin in the Zoological and Histological Laboratory.

D. S. KELLICOTT,

COLUMBUS, O.

Member of the American Microscopical Society.

How often in the memory of most of us has the suffering world been startled by the announcement, often by the highest authority, of some wonderful medicine, specific or elixir. These, one after another, have been put to the test and have taken their places among the useful

remedies, but on a plane below, often far below, the first claim and initial hope. Is it to be thus with Formaldehyde as an antiseptic, as remedial agent, as preservative, as a histological fixative? It can only find its true plane among its kind by conscientious trials made and reported by investigators. During the last year it has been used in the laboratory of the Ohio State University quite extensively as a preservative and for histological purposes. I have brought together in this paper the results and the reflections to which they obviously lead. Papers have appeared in the last year or two giving results from laboratories along similar lines. I may say at the outset that my experience leads to conclusions essentially in accord with results heretofore published.

In the statement of trials I shall by "per cent" mean per cent by volume of the forty per cent solution of formaldehyde in water, procured of Sharing & Glatz of New York, and distilled water. I have found this standard solution known as formalin fairly constant, and so a reliable solution may be thus quickly made of pretty constant strength.

I. As a preservative I have tried it on a variety of objects, using varying strengths with results to be noted.

Experiment 1. Small sunfish perfectly fresh was put into two per cent formalin Feb. 2; March 1 it was well hardened without shrinkage; colors fairly preserved compared with the best alcoholic specimens; eyes better; fins extended. The fluid was filtered, the bottle sealed and given a place on the shelf. July 1, no perceptible change observed.

Experiment 2. Two common eels from the market were immersed in four per cent March 11. July 1, examination showed that they were in perfect condition as to color, absence of shrinkage and firmness. The fluid had colored slightly and there was a sediment. Filtering ren-

dered the specimens fairly representative museum preparations, fit for systematic or anatomical purposes.

Similar trials were made with a variety of fish naked and scaled, large and small, with uniformly good results. A stronger solution, up to ten per cent, was found superior for larger specimens; the colors are better preserved in solutions as strong or stronger than three to four per cent.

Experiment 3. *Amblystoma jeffersonianum* killed with chloroform Mar. 1, put up immediately into two per cent formalin; at the end of four days it was found to be quite hard, color very slightly changed, costal grooves plainer than in the living animal. The fluid was filtered and was still clear July 1, while the preparation left nothing to be desired.

Experiment 4. *Amblystoma tigrinum* treated similarly but put into four per cent gave excellent results. So far as appears, for museum, systematic or anatomical purposes it was no better than specimen in experiment 3.

Experiment 5. *Amblystoma tigrinum* was killed April 5, with chloroform and the mucus washed off with water as in experiments 3 and 4; it was then placed in equal parts of ninety-five per cent alcohol and two per cent formalin. July 1 the specimen was far superior in appearance and preservation to any that I have ever been able to prepare by means of alcohol alone. I cannot say it is superior to that of experiment 4.

Other Amphibia and several Reptilia have been preserved in a water solution of formalin and in alcohol-water formalin with excellent results so far as the time that has elapsed permits of a demonstration. It seems to be the best method for Ophidia.

Experiment 6. A tongue of a lion was thoroughly washed in water to remove blood, mucus and dirt and treated February 5 to a five per cent solution of formalin.

July 1 it was found well hardened, in clear fluid with but slight indications of shrinkage.

A camel's tongue, larynxes of spider monkey, camel and kangaroo were cleaned, washed and preserved in from two to four per cent during February and March; they are at present fine preparations.

Experiment 7. Several trial were made to harden and preserve brains, with different per cents of formalin, with alcohol and formalin, and with formalin and bichromate. I will speak particularly of a few:

1. A brain of a spider monkey removed twenty-four after death was placed in four per cent formalin. In a very few days it was firm, remained white and did not noticeably shrink. July 1, it was all that could be desired in a museum specimen.

2. The brain of a kangaroo was hardened in forty or fifty per cent alcohol and two per cent formalin, equal parts; the results were no better; the specimen was as good and prepared in less time than by alcohol alone; and of course much more cheaply prepared.

3. Brains of dogs and cats were prepared for anatomical purposes by adding to the usual bichromate solutions one or two per cent formalin. A smaller quantity of fluid was necessary, not so many changes and a great gain in time; the material was excellent, not brittle and with fine contrasts.

Before stating my general conclusions as regards this agent in preserving museum and anatomical preparations, I would like to add a note as to its usefulness in another direction, viz., in preserving animals for dissection. If the subject is a small dog, its blood vessels are washed out with salt solution and 250 cc. more or less of five per cent formalin injected. Thus prepared and kept in a cool place, when not under examination, it may be used by the dissector day after day and for several weeks without unpleasantness. The brains of animals thus treated

may be removed for study much longer after death than in any other way known to me, at the same cost of material and time.

The advantages of formalin in the lines discussed above may be summarized briefly thus: It is cheaper than any other method that gives good results; it gives results in much less time; the colors are better preserved and there is less change of form by shrinkage or by swelling; its penetrating power is excellent so that insects, crustacea, etc., preserved in it are fit for work on the internal organs; for mollusks and vermes it is also excellent.

Its disadvantages should likewise be stated. It is extremely volatile and the jars have to be sealed with care. I have not had it in use long enough to decide how great an obstacle this will prove in the museum. Again, the water solution will freeze and not all museums are at all times above 0°C. In such cases, if not in all, hardening in formalin and transferring to the lowest per cent alcohol that will preserve would seem to be the better and cheaper way. I have not yet had the opportunity to demonstrate to what extent preparations thus preserved may be treated to additional alcohol to replace that lost by evaporation, without a precipitate.

II. Experiments with formalin for histological purposes were undertaken in February last. The visceral organs of *Cryptobranchus* were placed while perfectly fresh in a suitable solution of borax carmine with five per cent formalin; the third day the pieces were washed, the stain fixed and dehydration in sixty per cent alcohol commenced; they were passed rapidly through alcohols of increasing strength, and the end of seven to ten days were infiltrated with paraffin and ready to cut. The liver, intestines and kidney were sectioned, leaving nothing to be desired in stain or character of the cells.

Parts were at the same time hardened in five per cent

without bulk stain, also in dilute alcohol and formalin. We concluded that the rapidity and less shrinkage were alone sufficient to recommend the use of the new agent.

Mr. J. H. McGregor, who was conducting an investigation of the central nervous system of *Cryptobranchus* in the same laboratory, used the agent in combination with alcohol and other agents to his entire satisfaction. He will doubtless give his results when his paper is printed. Another student used it successfully in preparing the eyes.

I may say, in short, that the result of the few months of trial warrant a high estimate of it for fixing animal tissues.

Care of the Eyes.—In the earlier use of the microscope the care of the eyes cannot be too persistently urged. The wrecks of those wonderful organs along the shores of microscopy are too numerous to be ignored, or their lessons unheeded. Many more which have begun without rules have reluctantly abandoned the fascinating use of the instrument before utter instruction, but with impaired vision who, had they been governed from the first by the following hints, might have made comparatively weak eyes strong, and attained eminence in this pivotal, key-note, science and art.

(1.) Begin exclusively with your lowest power objective.

(2.) Until self-mastered use but one object at a sitting.

(3.) Lengthen the time only five minutes at each sitting.

(4.) Never begin work heated, angry, or greatly excited.

(5.) Stop instantly at the first scratchy-feeling in the eyes.

(6.) When two hours is not weary, you are safely initiated.

Now use the next higher power objective under the same rules, half of the sitting time at each sitting, and thus on, on, on, as necessity, or inclination beguiles or commands. "Excelsior, excelsior."

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CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

Carl Vogt, aided by Emile Yung, of the University of Geneva, has issued in two volumes of 900 and 1,000 pages with 798 engravings a work entitled, *Traite d'Anatomie Comparee Pratique.* He has long been associated with the laboratory of Comparative Anatomy and Microscopy at Geneva. The volumes can be bought from Schleicher Freres, Paris. Price, 64 francs, for the two volumes.

QUESTIONS ANSWERED.

NOTE.—*Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of all grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.*

240. *Where can I obtain Lecithin that I may try it on some of my patients by hypo injection?*

Listed by Merck & Co., New York, N. Y., 15 grain vial $2.50. It is a phosphoric compound from brain or egg yolk.

PRACTICAL SUGGESTIONS.

BY L. A. WILLSON,
CLEVELAND, OHIO.

Volvox globator.—This interesting object can now be found in many fresh-water ponds. When collected in a glass jar or bottle, it may be easily seen with the unassisted eye. They may be observed as little balls floating around in the water. They should be examined in a slide with a hollow cell; a very shallow cell is preferable, for in them the specimen may be examined with a one quarter or on fifth objective.

Glycerine Gelly for Mounting.—Many objects, especially objects containing moisture, are unsuitable for mounting in balsam. For such objects, as for instance mosses, liver mosses, stained leaf sections, spores and many others, are best mounted in glycerine jelly. The jelly can more conveniently be procured from a dealer.

Kaiser's Glycerine Jelly is composed as follows:—

Finest French gelatine, 1 part by weight; soak two hours in six parts by weight of distilled water. To this add seven parts of chemically pure glycerine and to each one hundred grams add one gram of carbolic acid; then warm and stir constantly for ten or fifteen minutes until all flakes disappear. Filter while still warm through funnel filled with glass wool. Before using the wool wash it and place in the funnel while still moist. The jelly should be warmed each time it is used. When using, warm the slide, place a drop on it with a glass rod and warm the cover glass before using. After cooling, ring the edge of the cover with varnish or cement.

Fixing the Cilia of Infusoria.—Use one part of tannic acid to four parts of glycerine. On placing a drop of water containing the cilicita on the slide drop a minute quantity of this fluid into the water and allow the two fluids to flow together. If the right quantity of the fluids is used the cilia will gradually become more and more distinct and will stand out plainly until the animal seems to be entirely surrounded by them.

SCIENCE-GOSSIP.

A New Adulteration of Senega Root.—In the early part of 1894, Ad. Andree of Hanover drew attention to an interesting adulteration found in senega root imported from New York, the drug containing 25 per cent of foreign root which he referred to as Richardsonia scabra. The structure of the drug, however, showed this identification to be incorrect; the starch in the two roots differed in character, and in the Richardsonia the oxalate of calcium assumed the form of raphides, while in the adulteration referred to it was present as cluster crystals. C. Hartwich, *Archiv. der Pharm.*, believes the root to be that of Triosteum perfoliatum, L., Caprifoliaceæ, which has recently appeared as ipecacuanha. Externally the roots showed the greatest similarity, and the histological and chemical examination proved their identity.

Triosteum perfoliatum is indigenous to the eastern and southeastern United States, and therefore might easily be collected with senega, although the two plants are very different in appearance. Triosteum is a shrub with a thick knotty rhizome, from which arise several stems reaching nearly 3 feet in height; it is known in America as tinker's weed, bastard ipecac, etc., and is used somewhat extensively as an antipyretic, purgative and emetic.

The drug consists of a yellowish brown or dark brown bent, knotty rhizome, to the sides and under surface of which are attached numerous roots, generally not over ½ ccm. thick, and often much thinner; these are lighter in color than the root stock, show here and there transverse fissures and resemble many varieties of false ipecacuanha, especially Richardsonia. In general appearance it is so like senega that its presence seems to have been overlooked; it differs, however, in the absence of a keel.

The structure of the root is very charcteristic. A transverse section exhibits a radiate wood without pith and a cortex, in which a narrow pale outer portion can be distinguished from a darker inner part. Next to the cork

is a layer of large compressed cells (primary bark) containing here and there a cluster crystal of calcium oxalate. Between this and the secondary bark is a layer of four or five rows of cork cells, the outer of which have undergone an unusual elongation in consequence of which the primary bark has become compressed, and is eventually thrown off. The cortex contains numerous cluster crystals of calcium oxalate and starch in compound or simple grains reaching 0 015 mm. in length The wood is remarkable for the fact that the medullary rays are lignified, while in the xylem rays only the middle lamella yields the lignin reaction.

The Triosteum root contains an alkaloid which Andree considered identical with emetine. Hartwich, however, was unable to obtain the characteristic reaction with hydrochloric acid and chlorinated lime and concludes, therefore, that the alkaloid is not emetine.—American Druggist.

Treatment of Diphtheria in Berlin.—During 1894 and 1895, 245 diphtheria patients at Am Urban Hospital in Berlin were treated with antitoxin with a mortality of 28 per cent while among the 146 who were treated otherwise the mortality was 42 per cent.; 53.2 of the serum cases were serious, 23.7 severe, and the rest slight. The effectiveness of the serum was proportionate to the earliness of its application and the strength of the first doses. The hospital reports conclude that antitoxin is not an infallible but a valuable remedy.

Leprosy is said to be spreading in the Russian Baltic provinces with alarming virulence. Several hundred persons are said to be afflicted with the disease, and the Livonian Diet has just taken measures for isolating them at the cost of the State.

Typhoid Fever caused thirty-six per cent of the deaths among the British troops in India during the year 1894.

RECENT PUBLICATIONS.

Traite de Physiologie humaine contenant l'Histologie et l'Anatomie microscopique et les principales applications a la Medecine pratique, par L. Landois. Un volume grand in-8 orne de 356 figures dans le texte. Cartonne a l'anglaise. Schleicher Freres, 15 Rue des Saints-Peres, Paris, 32 fr.

Professor Landois is Director of the Physiological Institute at Greifswald University. This translation into French is from the Seventh German Edition and is made by G. Mopuin Tandon, a professor in the Toulouse faculty of Sciences.

La Structure du Protoplasma et les Theories sur l'Heredite et les grands Problemes de la Biologie generale. Schleicher Freres, Paris.

This book, the remarkable work of Dr. Yves Delage, is addressed to philosophers and to students of scientific matters as well as to naturalists and medical men. The author has divided his work into four principal parts. The first part, entitled The Facts, is subdivided into three books: The Cell, the Individual, the Race. The second part treats of Particular Theories. In the third part are exhibited the General Theories of all the French and foreign authors who have treated these questions: Buffon, Bechamp, Herbert Spencer, Haacke, Dolbear, Erlsberg, Hackel, His, Cope, Orr, Mantia, Hanstein, Berthold, Chevreul, Geddes, Tohmpson, Gautier, Danilevsky, H. Fol, Maggi, Altmann, Wiesner, Weismann, Charles Darwin, Maupertuis, Erasmus Darwin, Galton, Jager, Brooks, Gaule, Platt-Ball, Hallez, Nageli, Kolliker, H. de Vries, O. Hertwig, Descartes, Roux. Then in the fourth part, after a comprehensive glance over the general current of ideas, we have, under the title of Theories of Existing Causes, an exposition of the author's ideas on these important subjects, which are now the questions of the hour.

THE MICROSCOPE.

Contents for May, 1896.

THE MICROSCOPE

JUNE, 1896.

NUMBER 42 NEW SERIES

Objects Seen Under The Microscope

BY CHRYSANTHEMUM.

XXXII.—THE SCALE OF INSECTS.

It is well known to every one that the dust which remains on the fingers after touching a butterfly's wing is a mass of beautiful feathers or scales, varying in shape and color with the different species. Some of these are so delicately ornamented that no unassisted eye can see them and some of them are used as test objects for the microscope. It is interesting to view parts of the wings as opaque objects, thus observing the arrangement of the scales which is much like that of the tile on a roof. (Figs. m, n, and o.)

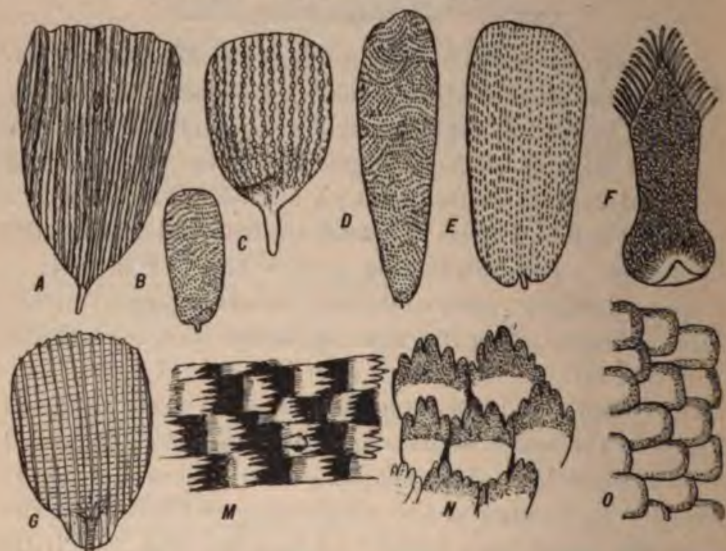
The common cabbage butterfly has several different shapes in the scales of its wings, some are very long and slender, some battledore shaped, while others are heart shaped. In looking at the wing, observe the membrane where the scales have rubbed off and you will see little cups or tubes into which the scales fit, and around each are radiating folds of the upper membrane, giving them a star-like appearance.

The Morpho-menelaus (fig. A), a blue butterfly, has striated scales, and with a high power each line is seen to be slightly beaded. Each scale consists of three distinct laminæ, two external and colored, and the inner one a highly polished colorless membrane, which reflects the light and increases the brilliancy.

Polyommatus argus (fig. C), another blue butterfly

and a frequenter of our cornfields, has peculiar scales shaped like a battledore with a long handle, and the longitudinal lines are swollen at intervals into rounded elevations, which give a dotted appearance, except towards the base, where a crescent-shaped cloud of minute pigment-cells crosses the scale, and forms a distinguishing mark of the species.

Scales can be mounted dry or in balsam and can be used as opaque or transparent objects. The silkworm,



moth (Bombyx movi) has a variety of scales, some toothed, some broad and some narrow, and it is said there are 400,000 of these scales on the wings of one moth. The scales from the under side of the little clothes-moth are very finely striated and make good test objects. Also those from the Podura (figs. B, D, and E), found in the spring about sawdust, under stones, and in damp places. It has six legs but no wings, and its body is covered with beautiful scales.

The Lepisma saccharina is the little silvery gray in-

sect which runs swiftly along and which haunts our sugar stores Its body is closely covered with delicately marked scales. These arc the Podura scales which were so much used as test objects (fig. D). Under a medium power they resemble watered silk, light and dark lines wove across the scale in irregular bands. But with a higher power the dark lines are seen to be rows of short lines, thick at one end, very fine at the other. Yet those apparent lines are not lines at all. Take a higher power still and with careful mangement of the light, we shall see that the apparent lines are really spaces between the wedge-like particles which make up the upper-layer of the scale.

The Diamond Beetle has groups of brilliant scales fashioned precisely like those of the butterfly's wings but owing to their iridescence, to the peculiar thinness of the upper layer and the reflecting power of the second layer, the color changes like that of a soap bubble. The dark cell in which the scales are set adding to their brilliancy.

At the sea-shore may be found the Machilis (fig. G), a wingless but active little insect commonly known as the Bristle Tail. Touch your finger to one of these insects and then to a glass slide and examine under the microscope. You will see myriads of the scales, some heart-shaped, some shovel-shaped, some round, oval elliptical, half round, half elliptical, long and narrow, sometimes irregular and unequal and of various other outlines, each scale has a minute footstalk which is not connected with it at either extremity, but at a point of one surface a little way from the smaller end, whence it projects at an oblique angle, so that when the stalk is incerted in its cell the scale will lay horizontally, covering the insertion (fig. G). This is a peculiarity not found in many other scales. The whole body of the scale is traversed by five close-set parallel lines running longitudin-

allÿ from end to end. Scales are sometimes triangular in shape, as in the Emperor Moth, deeply notched at the end, having from two to five projecting points longer even than the integral portion of the scale.

Pieris Glaucippe, a butterfly from China, has the scales tipped with a curious sort of fringe (fig. F). The scales are straight, parallel-sided, rather narrow, with a basal end rounded and the terminal extremity tapered abruptly to a point. It is on each slope of this point that the fringe is arranged. The surface is smooth, and excepting around the foot stalk, is filled with pigment grains, while the footstalk is turned in under the scale. Fig. M represents the scales from the Underwing Moth (fig. N), the scales of the Brimstone Butterfly and (fig. O), those of the Admiral Butterfly.

Use Of Ordinary Binocular For Dissecting.

BY JOHN TATHAM, M. A., M. D.

For many years past I have been trying to hit upon some simple method of using the stereoscopic binocular instrument for purposes of dissection, and of mounting slides for the microscope, because I have repeatedly found that the use of the best simple microscope for long periods does seriously impair the sensitiveness of the retina for observation with the compound instrument.

I have brought with me the stand which I now employ. It is a very small binocular, on the Rousselet model, and is fitted with a rack-work substage. Into this substage is fitted a brass ring carring a plate, or supplementary stage, of the form now shown. This supplementary stage is made of exactly the same width as the principal stage of the microscope, and the sliding object carrier of the latter is made to slide easily over the supplementary stage. The object of this arrangement will be shown

hereafter. When used for dissecting or mounting, the instrument is placed in the vertical position, on a table only so high as is necessary to allow of work in a sitting posture. A low power, say an inch or three inch, is screwed into the nose-piece. The objective is then racked down through the aperture of the principal stage, and is focussed on the object lying on the supplementary stage already described, a bullseye condenser, of the aplanatic form suggested by Mr. Nelson, being used in the case of opaque objects.

Two wedges, or inclined planes of wood, are arranged as supports for the wrists, one on either side the microscope, or in default of these a couple of thick books can be similarly used.

It only remains to be said that with the above simple arrangement, which certainly is not an expensive one, any small binocular can readily be converted into a dissecting microscope, or a mounting instrument, or it can be used with a four-inch or lower power, for the examination of animal or vegetable forms in sea water; and thus the mechanical adjustments of one's larger and more delicate instrument are preserved from harm.

The advantages that may be claimed for this "adaptation," which by the way may possibly be as well known to some others as to myself, are as follows:—

1. The use of the simple form of microscope, with all the discomforts incidental thereto, is avoided, and the binocular is available in place of the single tube.

2. The same "rack" microscope may be used, either for ordinary high power work or for dissecting purposes, by simply transferring the object and the sliding clip from the ordinary to the supplementary stage.

3. An instrument of relatively small size, and consequently with short rack work, may be used with long focus lenses, which otherwise can only be used in connection with full-sized stands.

4. An instrument such as the one I show this evening can be used with very great comfort in the sitting posture, with the arms and wrists resting on the inclining planes above described. This would be impracticable with a full-sized stand racked up so as to focus a three or four-inch power on an object lying on the ordinary stage.—Quekett Microscopical Club Journal.

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CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

The Mississippi Valley Medical Association.—A meeting of the Executive Committee of the Mississippi Valley Medical Association was held at Atlanta, on May 6th, and the following gentlemen were appointed to deliver addresses:

Dr. H. N. Moyer, Chicago, Address on Medicine.

Dr. Horace H. Grant, Louisville, Address on Surgery.

The indications are that the meeting to be held at St. Paul, on Oct. 20, 21, 22 and 23, will be the largest and most successful in the history of the Association. As all the railroads will offer reduced rates for the round trip, an opportunity will be given to visit St. Paul and Minnesota during the most delightful season of the year.

PRACTICAL SUGGESTIONS.

By L. A. WILLSON,

CLEVELAND, OHIO.

Crystals from Blood.—It is interesting and frequently of pathological importance to examine crystals in blood.

Crystals in blood are most readily formed, if a drop of blood be enclosed beneath a thin cover glass, allowed nearly to dry, and a small quantity of water be added.

To obtain haemin crystals, place blood on slide and add a drop of water containing a trace of salt; apply a thin glass; allow a little glacial acetic acid to flow in and mix with the blood. Then apply heat until the mixture almost boils. Examine the resulting crystals with a one fourth or one fifth objective. The haemoglobin crystals differ in shape in the various mammals. They are always of microscopic size and of a bright red color.

In man and most mammals they are of the shape of prismatic needles, or rhombic plates.

Melicerta Ringens.—This beautiful animal may be found both in fresh and stagnant water. A fine picture of this specimen may be seen in Dallinger's Carpenter, 7th ed., Plate XV, fig. 3. They are attached to roots and stems in the water. Their presence may be detected by the unassisted eye. They are generally in colonies. They are attached by a foot which is prolonged into a pedical. They build for themselves a sheath, or carapace of pellets which they secrete. This sheath is their permanent home. When broken they repair the damage. When alarmed they retreat into the sheath. When all is quiet, they protude from the sheath, unfold their arms and vigorously revolve their cilia. To the eye the sheath appears very dark brown, or nearly black. Under the microscope they are of an orange brown color. To examine, place the twig or rootlet containing them in a shallow cell and cover. They may be nicely seen with a one inch objective, but for finer details a higher power may be used. In collecting—gather the roots and stems from the water and place in a

flat bottle. "As a general rule old dark looking, but still sound and green branches will be the best." By placing them in a flat bottle, they may be examined with a pocket lens.

BEALE'S CARMINE.

Carmine	10 grains
Strong liquor of ammonia	½ drachma
Glycerine	2 oz
Distilled water	2 oz
Alcohol	½ oz

Dissolve carmine in the ammonia in a test tube by aid of heat; boil it and cool and add other ingredients. Filter.

SCIENCE-GOSSIP.

Chemistry in the Diagnosis of Bacteria.—Dr. Fritz Kiessling calls attention to the importance of this subject. It is a well-known fact that the differentiation of the colon bacillus from the typhoid fever germ offered serious difficulties till Dr. Theobald Smith used the fermentation tube test in differential diagnosis. Dr. Kiessling callsattention to such well-known physiological properties as peptonising of gelatin and blood serum. Such products of vital activity as the coloring of the medium as is *bacillus pyocyaneus.* Attention is called to acid and alkaline curdling of milk. Species that have the power of reducing nitrates to nitrites, the production of indol. Phenol is another common product. The production of acids and alkaline substances, scatol, kreatine. Acid or alkaline condition of the medium is important. Kiessling mentions many other substances that must be taken into account for special organisms.—*Pharmaceutische Rundschau.*

Oysters and Feeble Digestion.—One of the interesting observations made recently in the bacteriological department of the laboratory was in relation to the number of microbes in oyster juice. It was found that 1 c.c. of oyster juice produced in an agar culture, 1,500,000 colonies. The observation entirely justifies the position of the late

Dujardin-Beaumetz, one of the most eminent of French physicians, that oysters should never be eaten by persons with feeble digestive powers or those suffering from dilatation of the stomach. There is no article of food which decomposes more readily in the stomach than does the oyster, and none more likely to communicate infection through the setting up of decomposition and fermentation in other foods. The oyster is always a carrier of microbes, and recent observations show that it often communicates typhoid fever and other pathological germs. —*Modern Medicine.*

Transmission of Tubercle.—Jaeckh (*Virch. Archiv.*) investigated the question whether the sexual glands or their secretions contain virulent tubercle bacilli. He used the testicles and the contents of the seminal vesicles, as well as the ovaries of tuberculous patients who had died either of chronic pulmonary tuberculosis or of genera miliary tuberculosis. Portions of the sexual organs or of the semen were introduced into the abdomen of guinea pigs and rabbits. Of five cases in which portions of testicle or of semen were injected, positive results were obtained thrice with the semen and once with the testicular substance. All the rabbits remained healthy. Of three injections with ovary one gave a positive result. Examination of the young tuberculous female guinea-pigs gave only one positive result. It appears, therefore, that the semen may contain virulent tubercle bacilli, and that transmission of tubercle from mother to child is not the general rule.

Cholera Vibrio in Hen's Eggs.—According to an influential Russian daily paper, a Russian physician, Dr. Golowkow, has announced that he has conclusively demonstrated that the cholera vibrio can penetrate the shells of hen's eggs and enter the interior of the eggs.

Preservation of Blood for Examination.—H. Kral, chemist in Olmutz, writes to the *Pharmaceutische Centralhalle* that having on several occasions preserved the blood of lower animals for some time unaltered, under admixture of sul-

phuric ether, he has recently been able to perserve human blood in the same manner. For several weeks, he states, he has kept, in ordinary test tubes, lightly corked, human blood and on examination he finds it absolutely unaltered.

Examination of Spots on Wood for Spermatozoa.—Some time since we published a process accredited to Schumaker-Kopp, for facilitating this sometimes very difficult examination. Since then, having to make several examinations, we have found the following modification to answer better than the original. With a sharp knife remove the surface of the spot, either by scratching or by cutting a delicate sliver. Let the debris fall into a thin nearly flat watch crystal, and cover them with dilute water of ammonia for several hours, occasionally moving the material about with a dissecting needle. After standing for from four to six hours, carefully decant or draw off the liquid with the supernatant debris, leaving the precipitate on the watch-glass. To the latter add a little distilled water and let stand until the precipitate has again subsided. Pour off all of the water that can be removed without danger of disturbing the precipitate, and to the latter add a drop or two of picric acid solution or aniline violet. Stir up and remove the material with a pipette to slips, putting a droplet on each slip. Examine a slip by dropping a cover glass on the liquid. Sometimes the spermatozoa can be detected, but if not, let the liquid dry on the slip spontaneously, and then examine, either with glycerin or with dammar. Very rarely an entire spermatozoan may be found, but usually (where they are present at all) they will be found in a mutilated or broken condition.—*National Druggist.*

Bacteria in Oysters.—An outbreak of typhoid fever amongst those who attended the Stirling County Ball in October, 1895, gave rise to the suspicion that the oysters supplied on that occasion were the carriers of infection, but Dr. Chalmers, one of the Glasgow medical officers of health, investigated the matter and concluded that the cause of the enteric fever infection was not conveyed in the oysters. A bacteriological examination of oysters from

the same oyster-bed was undertaken later by Mr. D. M'Crorie, lecturer on bacteriology at St. Mungo's College, and he was able to isolate from them six distinct germs, of which four, including *Bacillus fluorescens liquefaciens* and a vibrio, liquefied gelatin. The fifth was a typhoid-like bacillus and the sixth a torula. The typhoid-like bacillus was found to differ considerably from the *Bacillus typhosus* of Eberth, Drs. Kanthack and V. D. Harris agreeing with Mr. M'Crorie on this point, and it was therefore assumed to be one of the pseudo-typhoids. It was found to differ from Eberth's bacillus in being virtually non-pathogenic to animals, and having a different optimum temperature, besides which it did not seem to posses so many flagella. The vibrio isolated was larger than Koch's cholera vibrio, but closely resembled the Finkler-Prior bacillus, and there was no reason to suspect that it played any part in the causation of the fever.—*Pharmaceutical Journal.*

Counting Blood-Corpuscles.—Dr. Judson Daland, of Philadelphia, has invented an instrument for counting blood-corpuscles, according to the *Physician and Surgeon.* It works on the centrifugal-force principle, and accomplishes the measurement by means of comparative bulks. A quantity of blood is placed in a finely graduated tube and the latter revolved at a speed of about 1,000 revolutions a minute. The corpuscles divide by force of gravity, and form on the sides of the tube in easily traceable divisions of red corpuscles, white corpuscles and serum. The new method permits of larger, and, consequently, more representalive quantitatives being used in experimenting, besides doing away with actual microscopic counting.—*Medical Times.*

A Process of Sealing Glass Vacuum Tubes.—In making vacuum tubes it has been the almost universal custom to attach a branch for exhaustion. But Mr. T. Bolas, who is well known to be an expert in this kind of manipulation, finds it much more convenient to avoid the extra branch and exhaust where a platinum wire is sealed in. For this purpose the end last closed is drawn out until the bore is

a little larger than the diameter of the platinum wire, which is now placed in position. The exhaustion being complete, the narrow tube around the wire is heated, and the glass becomes compressed around the wire. When cold the superfluous part of the tube is cut off, and it is then easy to free any required length of the wire from the glass by crushing with nippers or on an anvil, after which the seal is rounded off in the blow-pipe flame. In this way minute vacuum tubes like beads, the interior of which is but one-eight of an inch long and one-sixteenth of an inch in diameter, can be readily made, and, apart from decorative uses of such tubes in chains or festoons, surgical uses for minute high-vacuum tubes may possibly be found in connection with Rontgen's method of observing, and recording on sensitive surfaces.—*The Optician.*

Purification of Drinking-Water by Means of Filtration. —The report of the Massachusetts State Board of Health for the year 1894 contains some very interesting and important facts upon all these points.

For the past seven years the board has maintained an experimental station at Lawrence for the sole and express purpose of testing the efficacy of filtration of water to purify it and render it fit for household purposes. The water tested was that of the Merrimac River, which is lined from source to mouth with manufacturing towns, and which may be taken as a fair sample of river water contaminated with a considerable amount of organic matter.

The filters were of all sizes and thicknesses, from those a few feet square and ten inches in depth to the large filter covering two and one-half acres, through which the water supplied to the city of Lawrence has been filtered since 1893.

Chemical and bacteriological examinations were made weekly and sometimes daily of the water of ingress and egress. Sand of different sizes was used, and the filters were run both intermittently and continuously.

The result of this careful and painstaking investigation extending over a number of years and every source of

error being eliminated, are both astonishing and gratifying.

From a bacteriological standpoint they prove that a properly constructed and properly managed filter will remove from 98 to 99.84 percent of the ordinary bacteria in water, and that if such bacteria as the bacillus prodigiosus, which is very similar to the typhoid bacillus, be added to the water in varying proportions, the filter will remove from 99 to 99.993 per cent. The organic matter in solution is greatly diminished and the water is chemically purified.

Moreover, the efficiency of the filter instead of diminishing increases with age and use, owing to the formation of a gelatinous coating about each grain of sand, which serves to entangle the bacteria in their progress.

The rate of filtration may reach five million gallons daily per acre of filter without impairing the efficiency. If the surface-clogging is properly removed there will be no appreciable difference in the quality of the filtered water during or after the process of removal.

Finally, the cost of construction and maintenance of such filters is not so great as was supposed, and is not to be compared with the benefits derived from their use. The one which has been in successful use in the city of Lawrence proves that the plan is practicable in supplying cities with potable water. It seems to us that the knowledge derived from these experiments should be spread abroad and the attention of the municipal authorities called to them.—Medical Record.

Note on the Permanent Staining of Ringworm Fungus.—H. G. Adamson (*Brit. Jour. Dermat.*), for the staining of ringworm fungus, combines the caustic potash solution with the ordinary staining method. Dr. Adamson claims that the keratin nature of the horny tissues is lost by the use of the caustic potash, and that decolorization takes place as in non-horny epithelial tissues (*Am. Med.-Surg. Bull.*) The details are as follows: 1. 5-per cent-10-per-cent solution of caustic potash on the slide for ten to thirty minutes. 2. Wash 15 per cent alcohol in water. 3. Dry

the slide, and in the case of scales, fix by passing through the flame. 4. Stain in gentian-anilin-violet (made in the usual way by the addition of a few drops of saturated alcoholic solution of gentian-violet to anilin-water), fifteen to sixty minutes. 5. In Gram's iodine solution one to five minutes. 6. Decolorize in anilin-oil two or three hours or longer. 7. Remove anilin-oil by blotting paper and mount in Canada balsam.—*St. Louis Med. and Surgical Journal.*

Perservation of Mucilages and Pastes.—Considerable has been written from time to time about preservation for mucilages and pastes. Oil of cloves, creosote, carbolic acid, and various other things have been recommended, but none of them in my experience has served the purpose, and the paste-pot in the great majority of instances, is far from sweet-smelling.

For the use of the pharmacist a nicely made flour paste, in my opinion, is the most desirable adhesive that can be used; but unfortunately it is very prone to sour. Starch paste, even with the addition of glycerin, soon sours and becomes useless. In places where considerable quantities of paste are used this is not a matter of so much consequence, for it can be made in such amounts that it will be used up before it spoils, but to the retail pharmacist wishing to use it for his labels or to the photographer using it for his mounting, it is different, and so many have adopted the expedient of buying the patent pastes of the market.

Stepping into a leading drug store not long ago, I noticed a bottle of library paste sitting on his prescription case. I asked the proprieter whether he liked it better than flour or starch paste. No, he said, but he knew of no way of keeping these from souring, and so had been using the patent article. With a view of overcoming this difficulty I began a line of experiments during the month of November last, but failed to find anything that proved satisfactory for sixty or ninety days. When about to quit in disgust, the thought struck me that perhaps formaldehyde was the agent I was looking for. In order to give this agent as thorough a test as possible I made the following experiments and numbered them in the order made and

set them on the shelf where the temperature was usually very warm :

Experiment No. 1. (Date, January 20, 1896).—Mix 8 ounces of flour and 4 pints of cold water, and stir till free from lump ; add one-half ounce of pulverized alum, stir thoroughly and place in the water bath and boil till of proper thickness; then transfer to an earthenware jar, and when cool stir in one-half ounce of a 40 per cent solution of formaldehyde. This has stood from the time made till May 10 in the jar, covered but not sealed, and at the present writing I am using this paste as sweet and in as good condition as when first made.

Experiment No. 2.—Take of gelatin, 1 ounce; flour, 4 ounces; water, 3 pints; formaldehyde 3/8 ounce. Cover the gelatin with one pint of water and allow it to soften, then heat to dissolve, mix this with the flour and 2 pints of water previously made into paste, and boil them. When cool mix with formaldehyde. This paste at the end of sixty days showed no signs of spoiling, being fresh and sweet, although it had been exposed to a summer temperature all the time. Still it was necessary to keep it covered when not in use. A portion that was left uncovered for a week became watery.

Experiment No. 3.—Mix starch, 2 ounces, and water 16 ounces, and make a paste by heating. When cool add 1/4 ounce of formaldehyde. This was made on the same day as No. 2 and subject to the same conditions. It is in perfect condition at the present writing.

Experiment No. 4.—Mucilage of acacia, U. S. P., was made and 1 per cent of formaldehyde added. This has has now been standing for two months in a warm place and shows no signs of fermentation.

Experiment No. 5.—Make a thick paste from white dextrin, 4 ounces; and water, as much as required. Then add 8 ounces of flour paste made as in experiment No. 1, and 1/4 ounce of formaldehyde. This has been setting on the shelf for more then forty days and is as sweet as when first made.

Experiment No. 6.—To paste made as in No 5, but half the quantity of formaldehyde was added. This kept equally well. Thus it can readily be seen that by the use of formaldehyde paste or mucilage can be kept for months. —*Western Druggist.*

THE MICROSCOPE.

Contents for June, 1896.

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JULY, 1896.

NUMBER 43 NEW SERIES

Truth About Microbes.

BY WILLSON D. YOSTLING.

There was a period in the history of the world when "blood-letting" was regarded as a cure for every form of disease; there has also been a period now happily ending, when ethyl-alcohol, in the form of wine, ale or spirits, was supposed to be necessary in the treatment of maladies, and now, in 1896, we are suffering from what I am compelled to call "antiseptiphobia," by which I mean a belief upon the part of the public that most of the ills to which flesh is heir can be cured by the judicious use of microbicides. Indeed, since the establishment of the germ theory of disease, the world seems to have arrived at the conclusion that carbolic acid and similiar preparations possess powers almost allied to magic.

The substitution of the nasty smell of a drug—or chemicals—for the offensive smell of some other character is worthless as far as the destruction of micro-organisms and the prevention of disease are concerned. Further, no disinfectant for rooms can be of much value unless it can be applied to the walls and ceiling, as well as to the contents of the room.

As long ago as 1887, Dr. Alfred Carpenter, of England, condemned the use of carbolic acid, upon the ground that it tends to preserve the dormant germs from decay. Nor is this all, for Dr. George Sternberg, a high authority, has written that " experiments with

carbolic acid show that the popular idea, shared perhaps by some physicians, that an odor of carbolic acid in the sick room and other places is evidence that the place is disinfected, is entirely fallacious." Dr. Sternberg considers the fumes of sulphur and of peroxide of hydrogen reliable disinfectants, in the proportion of 1 volume of either to 100 volumes of air.

In this connection, it may be mentioned that, while micro-organisms require a certain quantity of oxygen to enable them to subsist, yet any considerable addition to that quantity appears, as a rule, to cause death. The inhalation of oxygen, which gas can now be obtained from the atmosphere at a very moderate cost, is likely to be thoroughly tested as an alleviative in lung diseases, and oxy-ærated water will undoubtedly be given a trial in cases of dyspepsia and diabetes.

There are three different classes of micro-organisms. This article deals exclusively with the pathogenic microbes—those which are productive of disease. The other two classes are zymogenic—productive of fermentation, and chromogenic—producing color. Low forms of life (call them animal or vegetable, as you please), such as microbes or micro-organisms, reproduce their species in different ways, some by fission, which is a simple division into two parts, each of those parts eventually becoming a perfect, full-sized adult: others by spores, or buds which grow at the end of prolongations, and ultimately leave the parent, thus becoming distinct individuals. The former variety has been named "bacteria," the latter "bacilli." The distinction between the two is of the utmost importance, because a degree of heat which will inhibit the growth of the most minute bacteria, is not likely to exercise any influence upon the spores of bacilli, although it may temporarily retard, or permanently destroy, the disease producing power of the full-grown specimens.

Every form of life, whether animal or vegetable, flourishes best under certain conditions as to temperature and food, or soil. To this law micro-organisms, of course, conform, and the presence of certain substances in the nourishing medium is essential to the growth of both bacteria and bacilli. Thus, disease-producing microbes do not thrive well if proteids and some organic salts are absent; or if the nourishing material is distinctly acid. Nevertheless, there is reason for believing some putrefactive germs—which must be near relatives to certain pathogenic organisms—are capable of rapid growth in acid medium. In addition, many pathogenic organisms remain inactive unless they are exposed to a certain degree of heat—about the temperature of the human body appears to suit them best—but their growth is quite rapid until from 86° to 100° Fahr. is reached. Heat above 140° Fahr. arrests the growth of many adult micro-organisms, and it may destroy some of them, although it probably has no influence upon the spores of the bacilli.

An "antiseptic" is a substance capable of creating a condition unfavorable to the growth and activity of micro-organisms.

A "germicide" is a substance which will destroy the vital action and the reproductive power of micro-organisms. If, after pathogenic micro-organisms have been placed in a nourishing medium to which carbolic acid has been added, upon the medium being exposed to such conditions of heat and moisture as are favorable to the vital activity of the organisms, the growth is retarded, the conclusion is often reached that the carbolic acid is a germicide, and that the disease-creating power of the microbes has departed for ever. This reasoning is fallacious, because the vital action of the organisms may simply be retarded, in a manner similar to that by which the application of cold inhibits microbic growth. In

order to sustain an assertion that the carbolic acid was anything more than a very mild antiseptic (if it is that), another experiment is necessary. The microbes must be removed and placed in a fresh nourishing substance. If they should then cease to grow, notwithstanding the presence of favorable conditions of heat and dampness, the conclusion would unquestionably be justified that the carbolic acid had injured or destroyed their vital activity.

Before a substance is pronounced a "germicide," bacteriologists take still greater precautions. After the germs have been exposed to the action of the hypothetical germ-destroyer, they are introduced into the bodies of suitable animals—such as are believed to be especially susceptible to the disease under observation—and if, after the lapse of sufficient time, and repeated trials, the disease fails to make its appearance, the substance may be pronounced a germicide, as far as that particular micro-organism is concerned. In cases involving microbes producing spores, the supposed antiseptic cannot be regarded as possessing any valuable germicidal properties unless it destroys the activity, not only of the adult organisms, but also of the spores.

It has already been mentioned that an abundant supply of oxygen is injurious to the activity of disease-producing micro-organisms; and this fact alone is sufficient reason for keeping our houses well supplied with fresh air, both in winter and in summer. A water-closet ought to be an apartment by itself (not a bathroom) of which the window cannot be fully closed, for if it can be shut there is sure to be some ignorant person who will shut it, thus enabling the noxious gases to circulate through the house.

The following facts seem worthy of attention.

Sporeless micro-organisms are destroyed in one and one-half hours at a temperature a little above 212° Fahr.

Spores of bacilli require three hours' exposure at a temperature of 284° Fahr.

The most competent authorities appear to believe that heat for less than half an hour at a temperature below boiling point has little influence upon the majority of the disease-producing micro-organisms.

The question so far discussed is the influence of antiseptics upon micro-organisms, and not upon the poisonous alkaloids known as "ptomaines," which, being generated by the microbes, are very often—if not always—the direct cause of disease. While germicides may destroy micro-organic life, nothing, except sufficient heat for a lengthened period, is at all likely to nullify the disease-creating power of the ptomaines. It should be clearly understood, however, that the filtration of water through a filter that cannot be properly cleaned, and the charging of water with oxygen, or carbonic acid—both very good things in their way—are useless as far as ridding the water of disease-producing germs of ptomaines is concerned. Let it be remembered that it is these ptomaines which produce typhoid fever.

Mr. Meillere of Paris has recently recommended the following mixture, as being a true antiseptic and also a pleasant deodorizer.

Zinc sulphate	1 pound
Sulphuric acid	35-70 drops
Essence of mirbane	15 drops
Indigo	to color

Mr. Meillere appears to think that this mixture will satisfy both the scientists and the laity, the confidence of the latter in an antiseptic being dependent upon the presence of a goodly supply of nasty smell, a desideratum which peroxide of hydrogen does not possess. Mr. Meillere's microbe-destroyer being highly poisonous is not of course, intended for internal consumption, but for use in sick rooms, etc.—*Popular Science.*

Geological Distribution of the Foramenifera.

By ARTHUR M. EDWARDS, M. D.,

NEWARK, N. J.

Foramenifera are widely distributed in geography, being found almost everywhere. They are also widely distributed geologically being found in the oldest rocks and so up to the most recent. And as they are seeming thus universal it is a wonder that they have not claimed and enjoyed a larger part of the labors of the naturalist. It is my wish to endeavor to clear up what is known of them here.

The designation Foramenifera was given by D'Ortigny in 1825 to an order of animals forming minute calcareous shells. They are for the most part many chambered, and often bearing a strong resemblance in form to those of Nautilus, Orthoceros, and other chambered shells or Cephatopods. He supposed Cepholopoda foramenifera to be distinguished from the real Cephalapada sipunculifero by the want of a "siphon" which passes from chamber to chamber in the latter, and its replacement in the former by mere "Foramana," at the dividing septa. This was where the shells alone were studied without the animals, now that the animals are studied it is found that they must be placed low down in the animal kingdom, in fact at the lowest where the Protista come in. For amœba, the lowest form of the animal, is related closely to the Foramenifera. It was the paper upon living Foramenifera by Dujardin, in 1836, that attention was first drawn to the existence of a type of animals more simple than any previously known, their bodies consisting entirely of an apparently homogeneous semi-fluid substance, to which he gave the name of "sarcode;" and this substance projecting itself through apertures of the shell into indeterminate ramifying extensions (which he termed pseudopodia) in the general mass of the body.

Regarding these animals as a section of the large group of Infusoria, whose bodies he supposed to have a like simplicity of sarcodic composition he distinguished as Rizopods, an account of the root-like diameter of their pseudopodial extensions.

They are found on the shores of New England where I have collected them at Swampscott, Massachusetts in the ripples of the sand at high water where they mark a white ridge and their shells can be got by washing off from the sand. They are also living there, as I have myself seen. On the algæ growing upon the rocks, perhaps they can be got everywhere else by looking for them on the sea weed. The sea weed should be cleaned, not by acids, merely washing it rather violently in a plentiful supply of seawater. The Bacillariariacæ, Foramenifera and such small fry will thus be washed off the sea weed and letting it stand for a time, can be searched with a dip tube and a common pocket lens for the microscopic atomies.

Dr. Carpenter says they are limited to the shallower seas near tropical shores, but certainly near tropical seas at Swampscott. So I should look for them everywhere away from the ice of the poles. They are found covering the coral reefs, they say, but as yet I have not found them in Florida. Perhaps it is because I have not searched the shores of Florida on the side of the Gulf of Mexico, and perhaps they will be found there by those more fortunate than I have been. In partially inclosed seas, as the Mediterranean and Red Seas also, they have been found. Perhaps the Gulf of Mexico will bear searching. They do not seem to live where the icy water of the North or South affects the sea. Besides, the carbonate of lime which is present in their shells seems to be present in warmer seas. But at Swampscott the Gulf Stream does not seem to bring them. Perhaps it is depleted by Cape

Cod. In enclosed seas we have the largest forms as obsculina.

Dr. Carpenter remarks that there is no division of the animal kingdom whose range in time (so far as is at present known) can be compared with the Foramenifera. Looking, indeed, to the vast series of ages that must have been required for the deposit of that long succession of upper Laurentian and Huronian rocks which intervene between the Eozoon limestone of the lower Laurentians of Canada, and in the lowest strata in which the most ancient representatives of the Palæozoic fauna have as yet been found, it may even be said that other fossils are modern by comparison. For the interval between the formation of the Canadian Eozoon and the period represented by the oldest fossils of the Lower Cambrian series seem undoubtedly to have been quite as great—geologically speaking—at that which intervened between the latter and the existing epoch, if not greater, the "fundamental gneiss" of Sir Roderick Murchison, which represents in central Europe the Laurentian of Canada, and near the base of which is found the kindred Eozoon bararicum, having a thickness estimated at 90,000 feet, and being overlaid by a great thickness of other non-fossiliferous rocks. Hence the determination of the organic origin of this Ophicolcite, and its Forameniferal affinities, which has been affected by the examination and comparison of parts of specimens so minute as to be scarcely visible to the naked eye, must be considered as one of the most remarkable results of microscopic reseach—fully equal in importance, when considered in all its bearings, to the discovery of Prof. Ehrenberg of the Forameniferal origin of the chalk.

As Prof. Gumbel says "The discovery of organic remains in the crystalline limestones of the ancient gneiss of Canada, for which we are indebted to the researches of

Sir William Logan and his colleagues, and to the careful microscopic investigations of Drs. Dawson and Carpenter must be regarded as an opening of a new era in geological science."

Note On An Optical Rule.

BY EDWARD M. NELSON, F. R. M. S.

The rule is made of box, is 20 inches long and square in section. On one face there is a scale of inches and tenths, and on the opposite side centimetres and millimetres. On one side of the sides at right angles to these is a scale of dioptrics marked D, and on the remaining side opposite to it is a new scale of powers of marked P. All the scales read from the same end and are ruled on both edges of the rod. This is important, because any two continuous scales can be read and compared together; thus dioptrics can be converted into inches by the inspection of one edge of the rod, and into centimetres by viewing the other, and vice versa. On the opposite face of the rod the scale of powers can be treated in a similar manner. The following are some examples of the use of the rule:—

(1). When the focus of a lens is measured on the P side of the rule, its magnifying power, when the eye is held at the back principal focus, is indicated. By adding one to this figure the power, when the eye is held close to to the lens, is found; but if one be subtracted from it, the enlargement of an image on a screen distant 10 inches from the lens will be enlarged three times.

(2). When the power of any lens is known, its focal length can be determined by inspection, either in inches or mm. Thus a lens of two-power has a focal length of five inches or 127 mm.

(3.) The focal length of a diverging lens can be easily found by overpowering it with a converging lens and measuring the power of the combination; this power, less

the power of the converging lens, is the power of the diverging lens. Its focal length can then be determined in either inches or mm., by inspection. Example: The power of a double concave, when combined with a bi-convex, is 0.85, as measured on the P side of the rule. The power of the bi-convex alone is 3.0; then 0.85, minus 3.0, equals minus 2.15. The focal length of the double concave is therefore minus 4.65 inches or 118 mm., these being the figures in a line with 2.15 on the rod.

(4.) The rule is very useful as a ready reckoner. Example (A): A lens of 8½ inches focus is combined with one of 94 mm. focus—required the power and focus of the combination in inches and mm., 8½ inches is in a line with 1.175 P, and 94 mm., in a line with 2.7 P. The power of the combination is, therefore, 1.175, plus 2.7, equals 3.875; this is in a line with 2.58 inches and 65.3 mm., the foci required. Example (B): I have a lens 178 mm. focus—what must be the focal length of the lens in inches that added to it will yield a power of 5? In a line with 178 mm., is 1.425 P; then five minus 1.425 equals 3.575, the power of the lens required; this is in a line with 2-8 inches, which is its focal length.—Quekett Microscopical Club Journal.

Reduction In Sulphates.—Spirillum desulfuricaus is the name of an organism obtained by Beyerinck from ditch water which has the property of reducing sulphates. It is a short spirillum, actively motile, but its motion ceases when oxygen is applied.—Arch. Neerland.

Does Tuberculin Accelerate Tuberculosis in Animals.—Prof. Nocard, the French veterinarian says: "The aggravation of tuberculosis lesions under the influence of tuberculin is a common fact in man, it is exceptional in bovines. I have observed but three cases out of 3500 injections that I made myself, and besides, when it takes place it is always upon animals with phthisis to the last degree and consequently useless."—American Veterinary Review.

THE MICROSCOPE.

New Series, 1893.

For Naturalists, Physicians, and Druggists, and Designed to Popularize Microscopy.

Published monthly. Price $1.00 per annum. Subscriptions should end with the year. The old series, consisting of 12 volumes (1881–1892), ended with December, 1892. Sets of the old series cannot be furnished. All correspondence, exchanges, and books for notice should be addressed to the Microscopical Publishing Co., Washington, D. C., U. S. A.

CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

Transactions of the Kansas Academy of Science.—The transactions of the twenty-sixth and twenty-seventh annual meetings of this scientific society, bound in a 400 page book, have just been received. This volume, XIV, edited by the librarian, is of unusual interest. Besides "Smal Things," address of the retiring President, Prof. E. S. Bailey, Lawrence; many valuable articles on geology, mineralogy, botany, etc., have interested us. In comparing the back numbers we find that the last one is certainly better than any other. The Kansas Academy is gradually becoming recognized by the best societies and scientific institutions of the world, and has for correspondents the prominent professors of all continents.

Field Flowers.—This is the title given to a beautiful book containing some of the most popular poems of Eugene Field. Thirty artists, the leading illustrators of America have very kindly donated their services in illustrating the work throughout. The book is published for the purpose of creating a fund, the proceeds of which will be equally divided between the family of the poet and the fund for the erection of a monument to his memory. Price $1.00; ten cents additional for postage. Address Eugene Field Monument Souvenir Fund, 180 Monroe street, Chicago.

PRACTICAL SUGGESTIONS.

By L. A. WILLSON,
CLEVELAND, OHIO.

Puccinias.—This form of fungus is now rapidly ripening. They comprise something over a hundred species. They are known as mildews or brands and attack and are found growing on a great variety of plants.

It is a matter of commercial importance to identify them and destroy them as they work havoc with crops of cereals and other valuable plants. No two species have spores alike; in this respect they rival diatoms for the microscopic student; besides they need no cleaning or manipulation. Finding an infected plant, scrape a little of a pustule, with a spatula, transfer to a drop of water on a slide, cover and examine with a quarter objective. If you are acquainted with this fungus purchase a lot of specimens from a dealer in microscopical supplies; most dealers have packages containing forty or fifty specimens which are sold very reasonably. Some of the spores are very beautiful.

Spot Lens and Paraboloid Illuminator Effects.—Nearly all the beauties of a spot lens or a paraboloid illuminator can be obtained by the use of oblique illuminator with a low power. Butterfly scales, scales of synapta, pollen grains and in fact nearly all objects may be beautifully exhibited by oblique illumination. This effect is well accomplished by turning the mirror aside from the axis of the microscope.

Arsenic.—The microscope is often an indispensable aid, in some of the tests for arsenic. The most common form of the crystal is octohedial or tetrahechol, but a right rombic form may be obtained by sublimation. Protoxide of antimony will also yield by sublimation similar crystals. The crystals may be seen with the microscope to the 10,-000 of a grain. In Marsh's test metalic arsenic is formed in the upper part of the test tube, which may be examined under the microscope. Sulphuretted hydrogen precipi-

tates the arsenic in a rich orange color and the antimony of an orange color. The yellow tint is apparent when only a one ten-thousandth part of arsenious acid is present.

Daldinia Concentrica.—Nearly every one who has wandered in the woods has observed on rotten wood little sub-spherical, hemispherical or long ovoid excrescences from one quarter to one half an inch in length. They are black spotted and resemble miniature plum puddings of the fairies dotted with tiny raisins. The excrescences are a fungus of the order Pyrenomycetes, sub order Dothideaceæ, genus Daldinia and species concentrica. The excrescences are the stromas.

To examine the plant cut the stromas in half with a sharp knife. The inner arrangement will be seen to consist of concentric layers. Place one of the severed halves under a dissecting scope.

In the top will be found a sort of a honey-combed layer composed of the perithecia; inside of the latter the asci will be found; they appear like masses of white jelly. Remove a few of the latter with a spatula to a drop of water in a slide; with forceps remove all dark woody and corky pieces and leave nothing but the white jelly-like masses. Cover and fill the space under the cover with a drop of water and examine with a quarter objective. The long pedicillate asci will then appear; in each ascus will be seen eight brown spores. The contrast between the brown spores and the hyaline acid will be exceedingly pleasing. The spores will be noticed to be obliquely uniseriate or arranged one spore overlapping the other in a single row. The little raisins on top of the pudding are the ostioles. A good picture of this strange and interesting plant may be found in plate 38 of North American Pyrenomycetes by Ellis and Everhart.

Blood in Urine.—May be suspected if the urine has a smoky or reddish -brown appearance, and may usually be detected in a satisfactory manner by the microscope showing blood corpuscles (these often do not show their characteristic biconcave appearance).

SCIENCE-GOSSIP.

Flax Retting and its Microbe.—M. V. Fribes in the laboratory of M. S. Winogradsky has determined the cause of this interesting industrial process. The organism causing the separation of fibers is a large bacillus 10–15 mm. long and 0.8 mm. broad. It produces a large tadpole spore 1.8 mm. by 1.2 mm. It was obtained in pure culture by cultivating the organism under anaerobic conditions on boiled potatoes containing chalk. The organism does not act on cellulose, it however ferments glucose, saccharose, and lactose, and starch when peptone is present. Experiments made showed that it had retting power.—Comptes Rendus.

A Disease of Melons. (*Alternaria sp.*)—Late in August specimens of musk-melon leaves were received at the station from Mr. S. B. Wakeman of Saugatuck. The leaves were evidently diseased, and Mr. Wakeman wrote that the trouble was spreading very rapidly over his melon ground notwithstanding applications of Bordeaux mixture. A visit to Saugatuck confirmed Mr. Wakeman's report. Of three large fields of melons, one was completely ruined, and the other two showed abundant evidences of disease. The trouble seemed to start at the center of the hills and extend rapidly outwards. It was characterized by a wilting of the leaves, followed by the appearance of small yellowish spots and blotches; these increased rapidly in size, the surface of the diseased areas became marked with dark, concentric rings, the tissues became dry and brittle, and upon all the older spots there was a copious growth of black mould distinctly visible with a lens. Microscopic examination showed that the leaf-tissue in every diseased spot was traversed by delicate, colorless threads, which, coming to the surface either singly or in little erect tufts, gave rise to short chains of large, brown, club-shaped spores, provided with a long erect appendage, and serving to place the fungus in the genus Alternaria. No other fungus was found in connection with the trouble, and this

together with the fact that the Alternaria was found abundantly in every one of the diseased leaves examined, produced a strong impression that the disease was due to the fungus in question. There was no opportunity however, to prove this supposition by the inoculation of sound leaves with a pure culture of the Alternaria. When the field was first examined, late in August, the plants had received two applications of Bordeaux mixture, but it had not been applied very evenly. The only thing to be done under the circumstances was to recommend another immediate and thorough application of Bordeaux mixture, especially upon those portions of the vines at a distance from the centre, which as yet showed no symptoms of the disease. There was but little hope however, of saving the crop to any great extent, and as the result proved, the disease continued to spread even after thorough treatment of the vines with Bordeaux mixture.

There are a number of fungi which are known to affect the leaves of melons, but the one in question is probably identical with the species of Alternaria recently described by Smith and by Peglion as affecting melon-leaves in this country and in Italy. Whether in this case the fungus was a true parasite, or whether it merely followed an injury due to other causes, must remain an open question for the present.—*Exchange.*

Chloral Carmine.—The following makes a beautiful and permanent carmine useful in almost every kind of work, and especially so in animal histology:

Carmine, No. 40.	50 cgm.
Alcohol	20 ccm.
Acid hydrochloric	2 ccm.
Chloral hydrate	25 gm.

Mix and dissolve.—*Nat. Druggist.*

The Lepra Bacillus has been found in the blood, as well as in the tissues, by Dr. Bouffe, of Paris.

Epithelium in Urine.—Under the microscope this is seen as irregularly shaped bodies,

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THE MICROSCOPE.

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THE MICROSCOPE

SEPTEMBER, 1896.

NUMBER 45 NEW SERIES

Objects Seen Under The Microscope

BY CHRYSANTHEMUM.

XXXIV.—OYSTER SHELL BARK LOUSE AND SCURFY BARK LOUSE.

The Oyster Shell Bark Louse is found upon the apple, pear, quince, hawthorn, buckhorn, raspberry, currant, linden, hop tree, bladder nut, horse-chestnut, maple, water locust, honey-suckle, ash, elm, willow and others. It has somewhat the shape of the oyster-shell, and generally attacks the young twigs or trunk of the tree. They are sometimes, though rarely, found on leaves or fruit. This in northern countries would mean certain death as they there have but one brood in a season, but in the south they have two broods.

If, during the winter, one of the scales be lifted, it will be found to contain the shriveled body of the dead female, under the more pointed portion of the scale, while behind this, the scale will be seen filled with eggs, white unless near the hatching period, which in the northeastern states is in May or early June, when they will be yellow. The eggs vary in number from 42 to 86 and when hatched, the young wander upon the twigs, and settle at once and commence to form the scale.

After inserting its beak and settling, the female molts twice, and begins the formation of the scale, which is secreted mainly from the hinder portion of the body and extends backwards. The insect has two molts and the

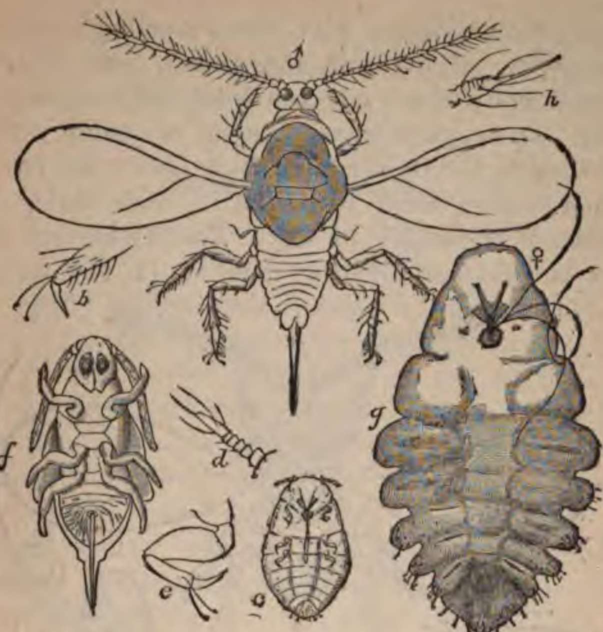
two cast skins remain in an overlapping position on the anterior portion of the scale.

The male scale is much smaller than the female, as indicated in the figures, and is otherwise distinguished by a few structural peculiarites. In the first place, there is but one cast skin at its anterior extremity, and in the next place, the hinder portion of the scale is hinged in

Mytilaspis pomorum or Oyster Shell Bark louse: a, female scale from below showing eggs; b, same form above greatly enlarged; c, female scales; d, male scale-enlarged; e, male scales on twig—natural size.

such a way that it lifts up like a flap, permitting the escape of the adult male. The different stages and structural details of the insect are so well shown in the figure as to require no further description.

SCURFY BARK LOUSE.—This scale insect occurs abundantly upon apple and pear trees, also on quince, black-cherry, currant and mountain ash, also on the Japan



Mytilaspis pomorum: a, adult male; b, foot of same; c, young larva; d, antennæ of same; e, adult female taken from scale;—a, c, e, greatly enlarged; b, d, still more enlarged.

Chionaspis furfurus or Scurfy Bark Louse: a, c, females; b, d, males—a, b, natural size; c, d, enlarged.

quince. As is the case with the preceding species the female scale, if lifted in the winter, will reveal the shriveled body of the insect in front and a mass of eggs behind. The eggs, however, instead of being yellowish in color, as in the Oyster Shell Bark Louse are purplish-red, and number from 10 to 75 in each scale. They hatch about the middle of May. The life-history of this insect is substantially the same as in the foregoing

Chionaspis furfurus: Adult male from above; b, foot; h, tip of antennæ of same; c, larva; d, antennæ; e, leg of same; f, pupa; g, adult female removed from scale—all enlarged; b, d, e, h, much more than the others.

species. The male insect, however differs quite radically in the character of the scale which it forms. This scale, instead of resembling that of the female in color and general shape, is very much smaller, brilliantly white, rather delicate, having nearly parallel sides and three elevated longitudinal ridges, one on each side and one in the centre. At the anterior end the yellowish-brown

cast skin of the first molt is very evident, its color contrasting sostrongly with thatof the scale.—L. O. Howard, U. S. Department of Agriculture.

Biology of Bacteria.

By W. D. FROST, M. S.

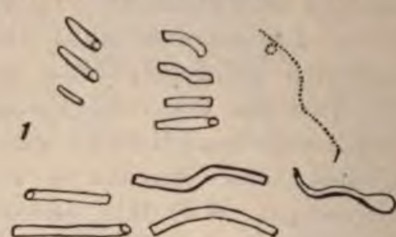
MADISON, WISCONSIN.

DISCOVERY OF BACTERIA.—Bacteria, with which the science of bacteriology deals, are the most minute forms of life; so small indeed that even with the high powers of a compound microscope used in other departments of science they appear as mere specks. On account of their tiny proportions, therefore, it is not strange that for many centuries they were unknown. In fact their presence could not be demonstrated until the microscope had become perfected sufficiently to be able to reveal their presence. This was first done when Anthony van Leeuwenhoek, of Amsterdam, Holland, who had become an adept in polishing lenses, was able to make the first really good microscope. With this microscope he saw in a drop of water what he called little animalcules, but the figures (see Figure 1) and descriptions of them which he sent to to the Royal Society of Great Britain in 1767 leave little doubt but that they were bacteria.

BACTERIA ARE PLANTS.–These little forms of life which at first we supposed to be animals, upon further study have been determined to be plants. The lowest forms of life are simply little particles of naked Protoplasm without any protecting membrane, or cell-wall. These are called myxomycetes or slime moulds, and are described and claimed both by the botanists and by the zoologists. Bacteria, while they are smaller, possess a cell-wall which protects the cell contents and gives them a permanent form, so they must be considered as more highly devel-

oped. There is, however, no differentiation in the bacteria into parts, such as root, stem and leaves, as in the higher plants, or even as in the moulds where the portion bearing the productive bodies is different from the growing part of the plant. So while not the lowest forms of life, bacteria are perhaps the lowest forms with a definite outline.

STRUCTURE OF BACTERIA.—Under a high power the individual bacteria are seen to be composed of a colorless, homogenous substance known as protoplasm. The cell wall is not always easy to see but is always present and by means of special reagents can be demonstrated. In some cases it is flexible but is usually quite rigid and has been found to consist not of a single layer but of at least



two. The outer one may be more or less mucilaginous in consistency; this often manifests itself as a capsule, as in the case of the organism of croupous pneumonia, see Figure 2, No. 1; in other cases it is indicated by the tendency of the individuals to unite or rather remain attached to their fellows.

THE SIZE OF BACTERIA.—As regards size bacteria are the smallest forms of life known.—The unit of measure employed in microscopy is a micron or 1-1000 of a mm. (about 1-25000 of an inch). Applying this measure we find the dimensions of many of the forms do not exceed a single unit. It is scarcely possible to realize their minuteness. If forms of this size were placed side by side there would be 25,000 to a single linear inch; 625,000,-

000 per square inch and 15,625,000,000,000 per cubic inch. This means that if human beings were no larger than these bacteria we could put the population of the world in a box an inch each way, the population of more than 8,000 similar worlds on top and shut down the cover without being afraid of hitting anyone on the head.

THE FORM OF BACTERIA.—In the above illustration it is presumed that the dimensions of the organism are equal in any and all directions; this is true in one type and such a bacterium is called a micrococcus, or little sphere. The other types are the bacillus, or little rod, and the spiril-

lum, or bent rod, which may take the form of a comma or even of the corkscrew. Between these forms there are many intermediate ones.

THE MANNER OF REPRODUCTION OF BACTERIA.—One of the characters common to all of the different bacteria is their method of reproduction, in fact it is upon this one characteristic that they have all been placed in a single class and called by the botanists schizomycetes, or fission fungi. If a single cell, provided with the necessary conditions of nourishment, is watched under a microscope it will soon be seen that the cell begins to elongate and when this has proceeded some little distance it can be

seen that at about the middle the cell-wall becomes drawn in and soon a new wall is completely formed between the two daughter cells, which in time become full grown bacteria.

THE RAPIDITY OF REPRODUCTION OF BACTERIA.—The rapidity with which the cells may divide and thus reproduce themselves is marvelous; under the best of conditions a single cell will divide once every half hour and it only requires a little work in compound multiplication to show that a single cell under these conditions will produce in twenty-four hours 16,777,220 baby bacteria and at the end of forty-eight hours the number will be 281,500,000,000,000. It is quite needless to say that the proper conditions for this rapid development are not maintained in nature for any length of time or the whole globe would long ago have been completely overrun.

CELL GROUPING OF BACTERIA.—Bacteria may occur singly or in groups and these groups are determined by two factors, the direction in which the cell divides, and the condition of the cell-wall. It will be noticed that bacilli and spirilla always form their new walls in but a single plane and that perpendicular to the long axis, so that these forms may be grouped in but a single way, in the form of threads, varying in length according as the condition of the cell-wall causes the individuals to adhere or allows them to separate. As examples see Figure 2, Nos. 6–9. In the coccus forms the plane of division may take many directions. Where two individuals remain attached they are called diplococci, Figure 2 (No. 1). Arranged in chains (No. 2), they are streptococci. In fours (No. 3) tetrads, while No. 4 represents groups of eight arranged in the form of packets and called sarcina.

CONDITIONS NECESSARY FOR THE GROWTH OF BACTERIA.—Bacteria, in common with the whole class of fungi, require that their carbon should be furnished them in the

form of a compound, such as sugar or proteid, since they have no chlorophyll and are therefore unable to utilize the carbon dioxide of the air as green plants do. Nitrogen is derived from either organic or inorganic compounds. such as proteids or ammonia, except one group (legume bacteria) which is able to employ the nitrogen of the atmosphere. Moisture is essential, for while desiccated bacteria retain their vitality for some time no growth takes place except in the presence of moisture. As regards temperature the range in which growth may take place is very wide and the extremes which prove destructive are still much wider. The lowest point at which growth takes place is about 45° F. and the highest about 110° F., although within a few years there have been isolated forms that grow only at a much higher temperature, 140° F. The most favorable temperature for ordinary forms is from 70°–100°F., the last being the requirement of the disease-producing forms.

If the temperature is congenial and moisture present it is surprising how small an amount of organic matter will support them. It has been found that certain forms cannot only live but can multiply with great rapidity in double distilled water where the only organic matter present is in the particles of dust on the receptacles which thorough washings failed to remove.

THE WIDE DISTRIBUTION OF BACTERIA.—The necessary conditions of growth, solutions of organic nitrogenous substances, are so widely distributed that bacteria are found almost everywhere on the surface of the globe, except in high altitudes, the air of mid-ocean, the deep layers of the soil, and in the circulating fluids of the normal plants and animal body.

RELATION OF BACTERIA TO DISEASE.—While many scientists both before and after Van Leeuwenhoek's discovery contended that bacteria were the cause of infectious

diseases, it was notuntil the researches of Davaine, Pasteur and R. Koch that positive proof was offered. Since that time the etiology(cause) of many of the contagious diseases has been determined and the life history of the organisms so thoroughly studied that the experienced bacteriologists can select them from a number of other kinds with the ease and certainty that a farmer separates the goats from the sheep. And while we do not know what organism causes even some of the most common diseases such as small-pox, rabies and scarlet fever, it simply serves to demonstrate the youth of the science and the vast possibilities before it. And when we remember what has been accomplished in the last two decades we can but stand amazed at the possibilities before us.

There is still much to be desired in our knowledge of infectious diseases and their therapeutics, but there is within our grasp sufficient knowledge of their manner of attack, as that with the proper care most of the diseases can be prevented, and the prevention of a disease is much more desirable than its cure.

The Mode of Infection by Bacteria.—Now that it is definitely settled that the bacteria are the sole cause of infectious diseases, it is interesting to understand their mode of attack. First, they may be inhaled and attack the lungs or respiratory passages, as in the case of pneumonia, tuberculosis and diphtheria. Second, they may enter the stomach with the food or drink and find lodgment in the intestines, e. g., cholera and typhoid fever. The third channel is through wounds, illustrated in the case of rabies and lockjaw. A few organisms like anthrax can enter the system in all of those ways. It finds its way into the body through the lungs in the "woolsorter's disease," through the stomach in cattle, causing splenic fever, by means of cuts in animals and man, the latter causing malignant pustule.

THE MODE OF ACTION OF BACTERIA.—A number of theories have been advanced to explain the way in which the bacteria act on the human system. One of the first theories advanced was that the bacteria deoxidized the blood, inasmuch as some diseases resemble asphyxiation. 'Another supposed that death was caused by the plugging up of the fine capillaries of the vital organs by the bacteria accumulated in them. Another accounts for the effects by assuming that the bacteria destroy the red blood corpuscles. All of the theories take for granted that the organisms in all cases are found in the blood, but this is not true. In the case of tetanus (lockjaw) and diphtheria the bacteria are localized. To meet these cases, the hypothesis was advanced which is now genererally accepted for all cases—namely that the wide constitutional effects are due to poisons manufactured by the bacteria and called toxines—Meyer Brothers' Druggist.

Diagnosing Typhoid Bacilli.—Lazarus has a made a clinical test of Elsner's method of diagnosing typhoid bacilli. He adds one per cent. of potassium iodide to Holz's acidulated potato-gelatin. Upon this medium the bacterium *coli* develops rapidly, forming at the end of forty-eight hours coarsely granular brown colonies. The typhoid bacillus, on the other hand, grows more slowly; the colonies at the end of forty-eight hours appearing like small, glistening drops of water with very minute granulations.

The stools of five patients with typhoid gave positive results during the first, second and third weeks of the disease. After the subsidence of fever, bacilli were occasionally found, in one case as late as forty-one days after defervescence. Repeated examinations are necessary, as negative results were shown at times to be false by positive findings at a second examination. In one case of typhoid, where remittent fever persisted, the bacilli were found in the stools even up to the ninth week, Negative results were always obtained in patients suffering from non-typhoidal disease of the intestines.—*Medicine.*

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New Series, 1893.

For Naturalists, Physicians, and Druggists, and Designed to Popularize Microscopy.

Published monthly. Price $1.00 per annum. Subscriptions should end with the year. The old series, consisting of 12 volumes (1881–1892), ended with December, 1892. Sets of the old series cannot be furnished. All correspondence, exchanges, and books for notice should be addressed to the Microscopical Publishing Co., Washington, D. C., U. S. A.

CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

A Monument to Pasteur.—It has been decided to erect, in one of the principal squares in Paris, a monument to the memory of Pasteur, and that this shall be done by voluntary subscriptions obtained in all civilized nations.

The Paris committee has therefore authorized the organization of a committee for the United States in order to give the people an opportunity to assist in erecting this tribute of appreciation. This committee for the United States is as follows:

Dr. D. E. Salmon, Chairman, Chief of the Bureau of Animal Industry.

Dr. E. A. Schweinitz, Secretary, President of and representing the Chemical Society of Washington, Chief Chemist Biochemic Laboratory.

Dr. G. Brown Goode, Treasurer, Assistant Secretary of the Smithsonian Institution, Dr. George M. Sternberg. Surgeon General, U. S. Army.

Dr. J. Rufus Tryon, Surgeon General U. S. Navy.

Dr. J. Walter Wyman, Surgeon General, U. S. Marine Hospital Service.

Prof. S. F. Emmons, U. S. Geological Survey, representing the Geological Society.

Prof. Lester F. Ward, President of and representing the Anthropological Society of Washington.

Dr. William B. French, Representing the Medical Society of the District of Columbia.

Hon. Gardiner G. Hubbard, President of and representing the National Geographic Society.

Mr. C. L. Marlatt, Assistant Entmologist, U. S. Department of Agriculture, representing the Entomological Society.

Dr. Ch. Wardell Stiles, Zoologist, U. S. Bureau of Animal Industry, representing the Biological Society of Washington.

The members of this committee will be glad to receive and transmit any funds that may be raised. They supply subscription blanks, which when filled will be forwarded to Paris for preservation.

American Microscopical Society.—The nineteenth annual meeting of the American Microscopical Society was held at Pittsburg, on August 18, 19, 20, 1896, under the presidency of A. C. Mercer, of Syracuse. An address of welcome was delivered by Dr. W. J. Holland, chancellor of the Western University. Among the papers read were the following: "Comparative Histology," by Prof. Edith J. Claypole; "Courses in Histology and Methods of Conducting them," by Prof. S. H. Gage, of Ithaca; "Photomicrography by the Use of an Ordinary Objective Practically Considered, with Specimens of Work," by Thomas J. Bray, of Warren, O. "On Astronomical Photographs, with Photomicrographic Apparatus," showing pictures of a partial eclipse of the sun taken on an eight-inch focus, by President Mercer: "The Antivivisectiou Bill," by Pierre A. Fish, of Chicago; The Acetylene Lights as Applied to Photomicroscopy," by William H. Walmsley, of Chicago; What is the Best Method of Teaching Micro-Science in Medical Schools? by Dr. Vida A. Latham, of Chicago; "The Structure of the Teeth and Spines of Some Fossil Fishes, Mazada and Ctena Canthus," by Prof. E. W. Claypole, of Akron, O.; "The Development of the

Brain in Soft-Shell Turtles," by Susanna Phelps Gage, of Ithaca, N. Y.; "The Rotifera in Sandusky Bay, by Prof. E. W. Claypole, of Akron, and D. S. Kellicott, of Columbus, O.; "On the Public Water Supply for Small Towns," by Dr. M. A. Veeder, of Lyons, N. Y.; "The Requisites of a Pure Water Supply," by Dr. William C. Krauss, of Buffalo, N. Y.

PRACTICAL SUGGESTIONS.

BY L. A. WILSON,

CLEVELAND, OHIO.

The Detection of Adulterations in Food.—A microscopist may accomplish a large amount of useful and practical work by examining and demonstrating adulterations in foods, drugs and commercial articles.

A substance will exhibit under the microscope particular appearances. A stranger introduced will at once be recognized. That one may know that a stranger is a foreigner, the first requisite is to know exactly the appearance of the pure article. To obtain this knowledge requires time, patience and perseverance. Having become familiar with the pure article it is very easy to detect the adulterations. It is practically impossible to deceive the microscope when its revelations are interpreted by an expert eye.

Keep the Eye Pieces Clean.—Once upon a time a dealer with a large invoice of nice bright golden microscopes descended upon a town.

He found an interested prospective purchaser. To exhibit a lens he placed a drop of his blood upon a slide, focussed and looked down the tube, when horror to relate he beheld every corpuscle teeming with bacteria. Cold perspiration streamed down his brows and cold chills coursed up and down his anatomy; when a veteran microscopist present took a look, turned the eye piece and discovered that the alleged bacteria were minute spots of dust upon the lower lens of the eye piece. This is a fre-

quent mistake. To avoid it clean the eye piece by breathing upon it and wiping off gently with a soft clean handkerchief.

Mounting Polycystina.—These shells may be mounted as transparent objects in balsam. In the latter medium they do not show to best advantage; neither are they perfect when mounted dry without preparation as they present too glassy an appearance. For perfect results heat them on platinum foil, mica or some other support by means of a blow-pipe flame or over a lamp. This heating will destroy the glassy appearance and render them opalescent. Then mount them as opaque objects and a beautiful slide will result.

SCIENCE-GOSSIP.

Baltimore Inspects its Bakeries.—The Board of Heath of Baltimore has appointed an inspector of bakeries, whose duty will be to make periodical visits to such places, and inspect material, utensils, and everything pertaining to the operation of baking. The aim of the department is a worthy one, and conducted upon lines sufficiently wide, should correct the typical unsanitary surroundings of such places, and insure cleanliness among those upon whom the care or carelessness of whose persons and their surroundings depends, in a great measure, the public health. —*American Medico-Surgical Bulletin.*

Flash-light Paper.—Flash-light paper, a dangerless convenience for photographic purposes, is prepared (Papier Zeitung) by coating one side of two sheets of calendered paper with starch or flour paste, then sprinkling upon the paste powdered magnesium, and pressing together, to cause them to adhere. After drying, a sheet similarly covered with powdered potassium chlorate is pasted upon each side, so that the powdered magnesium contained between the first sheets has a layer of potassium chlorate on each side. A further sheet pasted on serves as a covering, and the whole, which forms a thick sheet, can be cut into strips.

THE MICROSCOPE

Contents for September, 1896.

THE MICROSCOPE

OCTOBER, 1896.

NUMBER 46 NEW SERIES

Objects Seen Under the Microscope.

BY CHRYSANTHEMUM.

XXXV.—THE FANG OF THE SPIDER.

The spider (Clubiona atrox) that we find in our out houses, is an interesting object for study. It has long legs, moves very swiftly and builds a compact cloth-like web with a gallery open at each end for retreat in time of danger. Near such a web may sometimes be found a castoff skin. This is very suitable for examination under the microscope as every part; the fangs, the palpi, the legs with all their joints, the cornea of the eyes, the entire skin with every hair,—all are here in situ, with a clearness and transparency which it would require much skill in dissection to obtain, if a living spider were captured for the purpose.

There are in front of the head two stout brown organs, which are the representatives of the antennæ in insects, though very much modified both in form and function, being used by the spider as weapons of attack. They are composed of two joints, the basal one is the most conspicuous and consists of a thick hollow case of stiff chitine, somewhat cylindrical, but flattened sidewise. Its whole surface is covered with minute transverse ridges, and studded with stout coarse black hairs. Its extremity is cut off obliquely, and forms a furrow, the edges of

which are beset with polished conical points resembling teeth.

To the upper end of this furrowed case is fixed by a hinge-joint the fang, which is a curved claw-like organ, formed of hard chitine, and consisting of two parts,–a swollen oval base, which is highly polished, and a more slender tip, the surface of which has a silky lustre, from being covered with very fine and close set longitudinal grooves. This whole organ falls into the furrow of the basal joint, when not in use, exactly as the blade of a clasp-knife shuts into the haft; but when the animal is excited the fang becomes stiffly erected.

By examining the tip of the fang we see that it is not brought to a fine point, but that it has the appearance of having been cut off slantwise just at the tip; and that it is tubular, both the fang and the thick basal joint are permeated by a slender membranous tube, which is the poison duct. This connects with a lengthened oval sac where the venom is secreted.

When the spider attacks a fly, it plunges into its victim the two fangs. These act downward, not from right to left as do the jaws of insects. At the same time a very small drop of poison is secreted in each gland, which, oozing through the duct escapes from the perforated end of the fang into the wound, and rapidly produces death. The fangs are then clasped downward, carrying the prey, which they powerfully press against the toothed edges of the stout basal piece. By this means the nutritive fluids of the prey are pressed out and taken into the mouth. when the dried and empty skin is rejected. This poison is of an acid nature, as litmus-paper, when pierced by an irritated spider, is turned red as far around the perforations as the liquid spreads.

A Post Graduate course of bacteriology has been established at the Sidney University, N. S. W.

Primary Bacteriology.

Amateur bacteriologists complain that notwithstanding they have a good microscope and accesories, they have no ovens, culture tubes, petri dishes, and a great deal of apparatus which is listed in almost all of the catalogues, which they cannot afford to buy. Of course I admit that a well-equipped laboratory, which will probably in this state be found only in our leading medical colleges, is of great advantage and far more convenient; but he who wants to study can improvise the necessary apparatus to start his first investigations and hope that by the time he is ready to continue his research he will have fallen heir to wealth.

Let us talk of the preliminary work a little: We have a microscope but only have a one-fifth inch objective; we have been told that without a one-twelfth inch oil immersion lens and an Abbe condenser it would be fruitless to search for bacteria, and on account of the expense these valuable accessories have not been added. Some micro-organisms can be readily seen with a much lower power than a one-twelfth inch objective, as for instance the subject of urine which we now propose to take up.

Procure a bottle of your own or some patient's urine, allow to stand open in a warm room 36 hours, and from the surface, with pipette, take up a small drop of scum, as it appears without cover glass, place on an ordinary slip and examine with a fourth or fifth-inch lens, and many forms of living organisms will appear. I have seen every variety plainly and distinctly except the spirilla, and, of course, the flagella can not be discerned under such a low power. Their movements must not be mistaken, for the rapid evaporation causes currents, and, in fact, sometimes so rapidly do they move from under the field that is is impossible to follow them.

Now, having watched their movements carefully and

made a note of their size, shape and general characteristics, let us proceed further with the same slip, which we find by this time quite dry except in its center, and like the fish lying in the pond after the water has evaporated, we still have our beauties but they are dead.

Take a small drop of gentian and place in center of slip. You will readily note on examination that the rods will appear much plainer than before, but are thicker and shorter. The coloring matter has formed a layer upon them, and hence the apparent enlargement. The micrococci, staphlococci, streptococci, diplococci and sometimes sarcinæ, should not be overlooked. The Brownian movement should not be mistaken for the organisms surviving under the treatment of our straining process. Now, prepare another slip in similiar way and stain with alkaline methyl blue, and you may be able to discern in some single cacille a deeper color at the ends, or, possibly, a much lighter stripe in its middle than either body or ends.

Now, let us examine in the same manner a drop from a lower strata and see what we will be rewarded with, and for convenience, and a more prolonged study, with a camel's hair pencil and melted paraffine we will make a little ring on one slip just the size of our cover-glass. Put the drop of urine in the shallow cell thus prepared, drop on cover-glass and seal with paraffine, and if we are patient enough we can see in this hermetically sealed cell the cell division taking place in this flowerless plant called bacteria, and, under proper conditions, the growth would be quite noticeable within 24 hours. Of course the younger plant looks smaller than its mother plant, hence when the parent cell is ready to divide, it is no surprise to us to notice the difference in size. By using aniline stains of different strengths a great deal of information may be gleaned, and by mak-

ing cover-glass preparations something more learned.—*Langsdale's Lancet.*

The Physician and his Microscope.

BY A. A. YOUNG M. D., NEWARK, N. Y.

One of the most expensive and one of the most useless pieces of office furniture that the ordinary physician possesses is his microscope. It usually occupies a most commanding and conspicuous place in the office and decorated with "fuss and feathers"; valueless as an educator, valuable for the macroscopical appearances of the microscope, for it is capable of producing wonder and awe to the office visitor and shekels to the pocket of the physician.

Nothing can be said against the microscope as an instrument, for its value resides in its intelligent use, and unless used intelligently it becomes worse than useless, distorting facts and fancies alike, from which the observer can form no concept, can draw no conclusion save an erroneous one. The physician has to deal with the organic world, with those material forms in which resides that peculiar, unresolvable and unknowable agent we call life, and without which matter becomes comparatively valueless.

The microscope in the department of medicine requires for its intelligent manipulation a familiarity with anatomy, pathology, bacteriology, and last, but not least, biology, which subject scarcely ever enters into a medical college curriculum. We, as physicians, must deal with material forms that are endowed with life, and of that relation which exists between the material form and life we must have some concept, though it be partial and inadequate; for on the relation of things material or

*Read at the nineteenth annual meeting of the American Monthly Microscopical Society, Pittsburgh, Pa., August 19, 1896.

immaterial is the development of human thought possible. The life force of the bacillus is doubtless as intricate as the life force of the human subject and may be similar if not identical with it; for what is the body in which the ego resides more than an aggregation of amebæ specialized, and each ameba possibly having an independent life and having reproductive properties of its own. It is with the minute mass of matter, not the molecule, that the microscopist has to deal; he sees its manner and method of growth and not the forces which produce the molecular arrangement of the ultimate particles.

It is not enough that the physician be able to observe and differentiate the various forms of the micrococcus, spirillum or bacillus: he must know as well the habitat, manner and method of growth of each variety. Without this knowledge the revelations of the microscope are no more intelligible than some Egypian inscriptions. There is a philosophy of microscopy which is equally as valuable as the facts on which it is based, but a philosophy that can only be developed by accurate observation and classification of microscopical data. This work, it is evident, must be performed by the skilled microscopist and not by the novice, in which class the busy practitioner is usually found. In microscopical analysis no element relative to accuracy can with safety be omitted. It matters not though the microscopical accessories be thoroughly cleansed and sterilized, for the results would be equally untrustworthy if the material to be examined be placed in a receptacle, found perhaps in some old garret and half-cleansed. Conclusions reached under such conditions must be erroneous. Do you ask who ever allows such procedures? Go to the home of the amateur or pseudo-microscopist, observe his methods and technique and you will have the answer. It is surprising how much we see, how much we assume and how little we

know. A young physician asks an old one for the use of his microscope to examine a specimen of urine, assuring its owner that he is familiar with the instrument, having had instruction in college; permission granted, and slide prepared, and the observer exclaims, "The most beautiful specimen of a cast I have ever seen:" the owner of the instrument says, "That looks like vegetable matter and not a cast." "No," said the other, "that is a urinary cast; I have seen many of them." A microscopical examination of the container and its contents revealed a corncob for a cork; what the cast was you may readily infer.

A physician of several years' standing and the possessor of a good microscope at an autopsy of his announced that the patient's death was due to a disease of the kidneys, that she had been passing blood, pus, all forms of casts and other bad material with the urine. The autopsy, however, revealed ulceration with pus formation, degeneration and rupture of the gall-bladder, produced by impacted gall-stones, while the kidneys were practically normal, showing no structural degeneration. From whence, then, came the blood, pus, casts and debris, which was alleged to have been seen? These cases could have been none other than of mistaken identity; something was inferred that did not exist.

The conclusion is therefore reached, justly or otherwise, that the eye and understanding must be educated independently along certain lines before the manipulation of the microscope becomes satisfactory and trustworthy; objects must be seen and known relatively and in their entirety before being resolved into their component elements; the macroscopical appearance of an object must precede its microscopical appearance.

The physician must know in what menstruum and under what conditions the objects for which he is searching exists or are developed. Neither is it enough for him

to know and recognize the various forms of bacilli; he must be able to classify them and know their manner and method of growth, what they produce by their growth and what influence they have upon humanity. This is the philosphy of microscopy as relates to medical science. The microscope therefore becomes to the physician valuable in the degree that he is able to classify and arrange its revelations so that they may be read as from an open book. This faculty means a familiarity with the instrument born of time,—time which the "country doctor" must give by piecemeal, if at all.

I am no pessimist, although I see in a degree the passing of the microscope so far as it relates to the individual work of the ordinary medical practitioner. As already intimated, this passing is induced and sustained by unskilled and untrained eyes, which see much and individualize little.

The structure of microscopy, if it be enduring, must be built upon a comparatively errorless microscopy. The rank and file still have to learn that the microscope only enables the investigator to continue his eyesight, so as to observe the primary structure of an organised mass that would otherwise remain unknown and unknowable.

The first essential, then, for a physician microscopist, is the proper use of his eyes. supplemented by a keen intellect; what he sees he must be able to describe accurately, thus differentiating the various forms and figures that appear in the visual field.

Neither is it enough for him to recognize an object in an isolated condition and know its form and construction: he must know as well what relation it sustains to other objects about it. This calls for the exercise of the comparative faculty, the second essential for the physician microscopist; indeed, these two elements may be called his eyes. With these faculties undeveloped, untrained,

he may as well be a blind microscopist. What is true of normal vision is preëminently true of aided vision, which aid the microscopist, but it produces changes also in the relative conditions of objects, and of such changes the mind must take cognizance; it is an element too often overlooked. In short, the revelations of the microscope becomes the alphabet and the systematic arrangement of these revelations in the human mind forms its language, a language that requires study to comprehend ; a language also that needs much further devlopment and amplification. Physicians, as a rule, can be novices only in microscopical science, following where others lead; they stand at your feet, at the feet of the microscoscopists of the world, in the relation of pupil to teacher, asking for more light to illuminate the intricacies of human existence.

Give to them this light; save for them the microscope with all of its powers and possibilities which are vast ; prevent it by your efforts from relapsing into a state of "innocuous disuetude."

PRACTICAL SUGGESTIONS.

BY L. A. WILSON,

CLEVELAND, OHIO.

The Hepaticae.—These plants are the liverworts or liver moses. They may be found abundantly on the ground, on rotten wood, on stones, near water falls and on moist rocks. The eye easily distinguishes most of them from true mosses. They require the microscope and generally low powers for their investigation. They are beautiful and interesting; when gathered they may be kept in boxes and when examined in a drop of water always look green and fresh and in the dead of winter remind us of the woods and fields. They are analyzed chiefly by their leaves which furnish an almost endless variety. To ex-

amine cut off a sprig about one half of an inch long, place on a glass slip in a drop of water, cover and then see that the cover is completely filled with water. An inch objective is all that will usnally be required. It frequently requires sharp eyes to observe the under leaves which frequently aid in the determination of species.

An Improvised Erector.—For dissecting or manipulating under the microscope it is necessary to erect the image, at least, in order to work with comfort or precision. A cheap erector may be quickly improvised by fitting a right angled prison over the eye piece with the widest face from the observer.

Logwood Staining.—To bring out details of structure and display cell walls, etc., there is no better stain than logwood, and for singly stained vegetable sections it is to be recommended in preference to all other staining fluids. A logwood violet fluid is prepared as follows:

1. Haematoxylin .... 20 grains
   Absolute Alcohol .... 1-2 ounce
2. Solution of 2 grains of alum to one ounce of water.

To stain proceed as follows:

First:—Remove the sections from alcohol to water for a few minutes.

Second:—To alum solution for ten minutes.

Third:—Stain in No. 1.

Fourth:—Place in alum water to remove stain from surface.

Fifth:—Wash thoroughly in water.

Sixth:—Place in alcohol for two or more hours. Float the section lightly on the surface of oil of cloves—when it sinks it is ready to be mounted in balsam.

A Comparison of Lenses.—A novice recently purchased a lens from an itinerant agent of a foreign manufacturer. With the lens he also purchased a slide of Pleurosigma angulatum. Upon the grand resolution of this slide the novice based his opinion of his new lens.

Full of faith and confidence he carried his lens and slide

to a friend. The novice displayed his acquisition. The friend exhibited a balsam mount of the same frustule under a fine Spencer 1-6 objective. The Spencer resolution seemed to be cast entirely in the shade. It developed, however, that the diatom under the foreign lens was mounted in naphthaline monobromide. When the balsam mount was placed under the foreign lens the Spencer lens resumed its well-deserved gigantic proportions. Moral: A novice should never purchase a fine lens without the advice and inspection of an expert.

QUESTIONS ANSWERED.

Note.—*Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of all grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.*

Q. 243.—Where may be obtained the substance "Gum Thus"? F. F. E.

A. An order placed with Wm. Schieffelin & Co., Druggists, New York, will probably bring Gum Thus.

Q. 244.—What is the name of the best book giving methods of staining, especially double staining for both plant and animal specimens? F. F. E.

A. The methods of Microscopical Research by Arthur C. Cole, or Practical Methods in Microscopy by C. H. Clark, will be found useful.

SCIENCE-GOSSIP.

The Poultice a Hot Bed of Bacteria.—Dr. J. C. Biddle, in the Lehigh Valley Medical Magazine, calls attention to the abuse of poultices, and says he has seen many cases, where the application of a poultice has done irreparable damage. He has seen many cases where poultices were applied to abrasions, contusions, sprains, simple and compound fractures, until the skin and underlying tissues

wêre water-soaked. "Should this be done," he asks, "with our present advanced knowledge of medicine and surgery?" Most certainly not. The ordinary poultice has no longer a place among the resources of the aseptic surgeon or the practitioner who has any knowledge of bacteriology.

The poultice is a hot-bed for bacteria, and, such being the case, should not be used, especially where the circulation or tissues have been destroyed, as in an injury of any kind. For this reason I teach that we should cease applying the culture medium of the streptoccocci and their congeners. As a general rnle uninjured epidermis is impervious to organisms, but when we soften it, as with a poultice. we open the sweat ducts and give the micro-organisms easy access to the tissues beneath.

Syphilis from a Flea Bite.—Jonathan Hutchinson reports a primary lesion of syphilis of unusual origin. An elderly member of the profession presented himself, covered with an evidently syphilitic eruption, which rapidily disappeared under the use of the mercury. A careful examination of his entire surface revealed no trace of lesion whatever on the genitals or at any point, except a dusky spot on one leg, which looked like the remains of a boil. This, the doctor stated had been due to a small sore, the dates of the appearance and duration of which were found to fit exactly with those of a primary lesion. There had also been some enlargement of the femoral glands. He had never thought of the sore in this connection, but remembered most distinctly that it followed a flea-bite in an omnibus. Mr. Hutchinson concludes that all the evidence tends to show that the disease had probably been communicated from the blood of an infected person through the bite of the insect.—*Medical News.*

A Rapid Method of Affixing Paraffin Sections on the Slide.—A small drop of Mayer's albumin mixture is placed in the middle of a slide, and the section, from the microtome knife, laid on this drop. The drop forms a cushion and partially flattens the section. A piece of thin, smooth

writing paper is then coated with albolene (liquid vaseline), and the oily slide laid directly down on the section. With the ball of the thumb or finger firm pressure is made on the paper over the section; upon removing the paper the section will be found perfectly flat and firmly adherent to the slide. The slide is gently heated over a flame until the paraffin melts, and then it is placed in a jar of benzine or xylol to dissolve off the paraffin, when, after treatment with 95 per cent. alcohol, it is ready to be stained in any way desired. The albumin is forced away from the immediate neighborhood of the section by the combined action of the pressure and melting of the paraffin. The pressure should be made *directly down* on the section, and may be exerted to any degree without injury to the most delicate section, if the thumb is not allows to slip or twist. Care must be taken not to *rub* the paper as it lies upon the section, for in this way the section is often made to stick to the paper.

It will be seen that this method is very rapid as well as very simple; its results are all that can be desired in routine work, and it can be very readily grasped by the laboratory student.—Med. News.

Microtomes.—The attention of the Biological section of the British Association was drawn to the construction of microtomes by a communication from Prof. C. S. Minot, of the Havard Medical School, Cambridge, Mass. In recent years there has been a growing and justified demand for microtomes to make good sections of great thinness, if possible, not over one five-hundredth of a millimetre or 2 microns (0·002mm.) In the automatic microtome, worked by a revolving wheel, devised by Prof. Minot, which was now made in England, Germany, and France, as well as in America, the attempt is made to secure mechanical perfection, and so far successfully, that sections of 1-300mm. may be made with it. This microtome is, however, adapted only to cutting objects imbedded in paraffin.—Eng. Mechanic.

Tobacco and Cholera.—A recently published report of

investigations of the effects of tobacco during the epidemic of cholera at Hamburg states that there were no live microbes after twenty-four hours in the cigars made up with water containing 1,500,000 cholera microbes to the cubic centimeter. There were no traces of microbes to be found in any of the cigars manufactured at Hamburg during the course of the epidemic. The microbes die in half to two hour's exposure to tobacco smoke, Brazil, Sumatra or Havana tobacco. The smoke of any cigar kills the microbes. The smoke kills in five minutes all the microbes in the saliva. Another fact established is that none of the persons employed in the tobacco factories at Hamburg, contracted cholera.—Gaz. degli Osp. e delle Clin.

Typhoid Fever Caused by Ice Cream.—According to the Boston Medical and Surgical Journal, August 27, a considerable, but not widely extended, outbreak of typhoid fever occurred during the latter part of July in the town of East Barrington, N. H. The cases were all traced to a single source. The first case was an unrecognized one, the patient being unwell but helping about the house and doing part of the milking. It is supposed that he must have in some way contaminated the milk, as by going to stool and not washing his hands before returning to his milking. The water supply was carefully examined and found to be all right. On Friday evening a party was given at the house and the guests were given ice cream made at home from the milk supply above referred to. Within the next ten or fourteen days fourteen of the guests came down with typhoid fever—eight in the town of Barrington, of whom one died; two in Lee; one each in Dover, Rochester and Woodbury, N. H., and one in Haverhill, Mass. All of these out-of-town cases were guests at the party. No other cases occurred in the town, and all were partakers of the cream.

Zeiss Microscopes are joys forever, and would doubtless have been in much greater demand were it not that a stand with coarse adjustment by rack and pinion could not until recently be obtained for less than £7 10s. A smaller

stand, however, is now supplied for £5 5s., and this when properly equipped with the necessary lenses will serve every purpose for students and even practicing pharmacists. It has a fixed stage, 80 mm. square, rack and pinion coarse adjustment, and micrometer screw fine adjustment. The stand inclines, and the tube when fully extended measures 160 mm. long. Fitted with Zeiss achromatic objectives, A and D; Huyghenian oculars, No. 2 and 4, and a suitable condenser, the instrument is sufficiently complete for a student's use, whilst the further addition of a 1-12 inch oil immersion objective would make it suitable for all-round work in the pharmacy.

WATSON AND SONS, London, list a number of useful novelties in micro-apparatus, including "parachromatic" objectives, wherein a fair ratio of aperture to power is maintained for a moderate price; an excellent "parachromatic" condenser, N. A. 10, costing but little more than the ordinary achromatic condenser; and an improved Abbe model camera lucida in aluminium, the advantage gained by the use of this light metal being considerable. The Edinburgh Student's Microscope is now supplied in almost all conceivable styles, and should specially recommend itself to pharmacists.

Impure Water in Indiana.—In Johnson county, Indiana, there is a village known as Rock Lane. Connected with the Rock Lane Church is a well from which a large proportion of the people of the neighborhood drink. Over seventy-five per cent of these people have during the past year suffered with typhoid. The water of this well has been examined and found to be infected badly with intestinal bacteria. Even a chemical anaylsis showed a bad condition of affairs. It was along time before any one discovered that all the people taken ill were attendants at the church and that the non-church going people were immune.

Professor A. N. Prentiss, formerly professor of Botany at Cornell University died at his home in Ithaca, Aug. 14.

THE MICROSCOPE

Contents for October, 1896.

THE MICROSCOPE

NOVEMBER, 1896.

NUMBER 47 NEW SERIES

Objects Seen Under the Microscope.

BY CHRYSANTHEMUM.

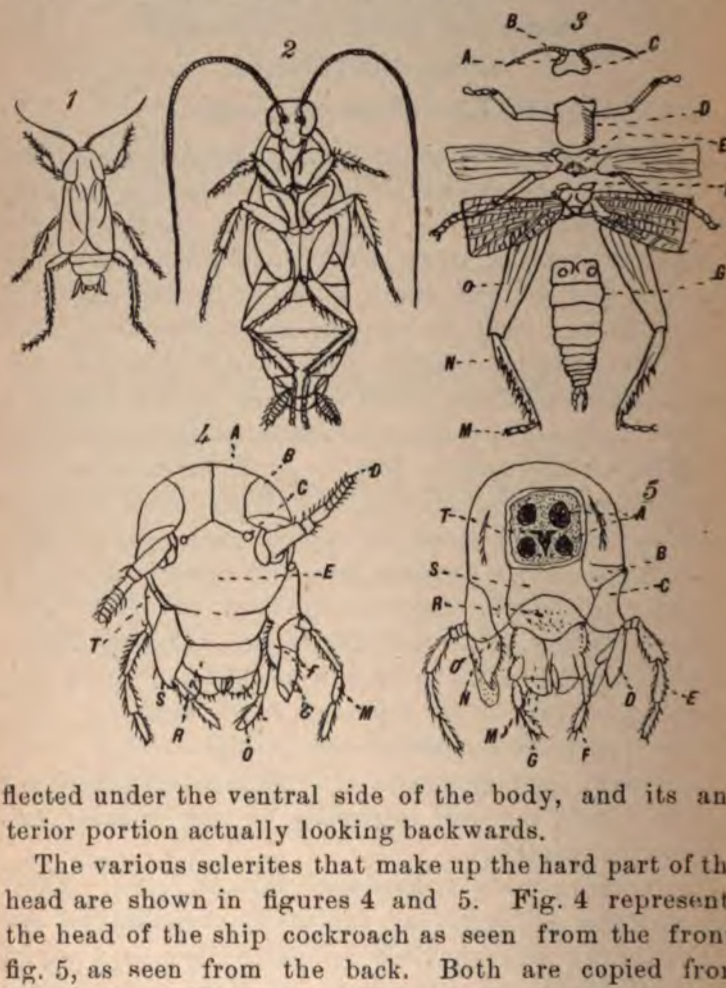
XXXV.—THE COCKROACH.

The scientific name of the common kitchen blackbeetle is Periplaneta orientalis; periplaneta meaning to wander, orientalis because of its coming from the east. The cockroach found on ships is Periplaneta americana and it is this that we will study it being larger than the other although they are very similar in structure. They are nocturnal in their habits, love warmth and shun the light. They are easily killed for study by chloroform.

STRUCTURE.—The elongated body is flattened from upper to under surface, and is roughly oval in cross-section. It presents three regions (figs. 1 and 2). Fig. 3 represents the general plan of the typical insect body. The head (fig. 3 c.), carrying the jaws and sense organs; the abdomen (g), within which are the most part of the digestive, circulatory, respiratory, secretory, nervous and reproductive organs. The head apparently of only one segment, is really of six segments fused together. The thorax is of three segments; the prothorax (fig. 3, d); mesothorax (e); metathorax (f). This external segmentation is only repeated internally in the muscles and the nervous system.

The exterior body is hardened into sclerites. These are cuticular and chitinous, and are thicker, harder and darker brown over the body generally than they are at the joints where the integument is softer and more pale.

The head is bent backward or reflected, and bent downward or deflected so that it cannot readily be seen from above and what looks like the front of the body from above is really the dorsal part (pronotum) of the first thoracic somite, prothorax (fig. 1). Fig. 2 shows the under or ventral, aspect of the body with the head de-



flected under the ventral side of the body, and its anterior portion actually looking backwards.

The various sclerites that make up the hard part of the head are shown in figures 4 and 5. Fig. 4 represents the head of the ship cockroach as seen from the front; fig. 5, as seen from the back. Both are copied from Marshall and Hurst's work.

The epicranium (a) covers the dorsal and posterior region of the head. It has a median suture or seam (fig. 4) that divides anteriorly into two, running out, right and left, to pale oval patches, the fenestræ, meaning windows, the clypeus (fig. 4 e) meaning a shield. The genæ (fig. 4 t) cover the sides. The left gena has been removed in the figure.

Between the head and the thorax is a constriction, the neck, on which are seven sclerites.

The prothorax is not rigidly articulated onto the mesothorax and its pronotum is longer than either the mesonotum (dorsal aspect of the mesothorax (fig. 3 e), or the metanotum (dorsal aspect of the metathorax (f). The abdomen (fig. 3 g) is of ten somites. The full number cannot always be counted. When the cockroach is looked at from without, some of the somites slip under and over one another like the joints of a telescope. The abdomen is broad from side to side, flattened from above downwards.

The food of the cockroaches is mixed. They can eat pretty much everything but they prefer dead animal matter. They eat their own cast off skins and egg capsules. They do not eat a great deal and grow but slowly. One of them has been known to live as long as five years.

The parts surrounding the mouth may be seen after fixing the cockroach on its back by pins passing through the sides of the pronotum. Bend the head from its reflexed and deflexed position forwards and upwards, and fix it by crossed pins.

The lips are seen to be two; an upper, the labrum, (fig. 4 r), and the lower, the labium (fig. 5 r, s). The labrum is articulated on the front edge of the clypeus (fig. 4 e) which represents the front view of the head. The labium is made up of two parts, the mentum (fig. 5 r) and the sub-mentum (fig. 5 s) which represents the back view of the head, mentum, the chin. The labium has also certain

extensions or feelers, the labial palpi (fig. 5 f), which have each three joints.

To see the jaws, remove the labrum (fig. 4 r), and also, as has been done in this figure, the gena and mandible (fig. 4 t, s). All parts thus removed from around the mouth should be mounted in glycerine, and examined under low powers of the microscope.

The jaws consist of three pairs,—one pair of mandibles (fig. 4 s), and two pairs of maxillæ. In figure 4 the left of the first maxilla is well shown to the reader's right, and some of its divisions are lettered f. g. m. In figure 5 the left first maxilla also is shown and some of its divisions are lettered b. c. e. The second pair of maxillæ are both shown in figure 4 and the left one is marked n. All these six jaws are biting ones.

The mandibles (s) lie below the genæ (t) and are articulated to the epicranium (fig. 4 a) and clypeus (fig. 4 e). They are strong and toothed.

The first maxillæ present a subdivision of the appendages of the body that run through the whole of the classes of the Arthropoda or jointed footed animals. A basal part, the protopodite, and two parts attached to the distal end of this, one nearer the middle line of the animal's body (the endopodite) the other farther away from it (the expodite). In the maxilla of the cockroach, protopodite consists of two joints, called respectively the cardo, (fig. 5 b) and stipes (fig. 5 c),—cardo, a hinge; stipes, a log. The endopodite is of two parts, the lacinia (fig. 4 f) on the inner side, the galea (fig. 4 g) on the outer side. Lacinia means a lappet; galea, a helmet. The exopodite is the maxillary palpus (figs. 4 m, and 5 e) with two short basal joints and three longer terminal joints.

The protodites of the second pair of maxillæ are fused together in the labium with its mentum (fig. 5 r), and submentum (fig. 5 s) already described. The endopodites

are also fused together into the ligula (fig. 5 m) and the paraglossa (fig. 5 g). The expodites are not fused and constitute the labial palpi (figs. 4 o and 5 f).

We are indebted for the facts in this article to E. Aveling's contribution in the *English Mechanic.*

(*To be continued.*)

What Can a Boy do with a Microscope?

By E. E. MASTERMAN.

NEW LONDON, OHIO.

Having made an effort to encourage microscopy among the boys and girls, I feel, in a measure, that I should write you something in favor of it.

I have had many questions confront me, among which I choose two, viz:—"What can they accomplish with a microscope?" and "What sort of a microscope do they use?

To the first I could give a great many answers; upon the second always has depended, in my observation, the sum of money at the boy's command and the encouragement he received from others. Though speaking of boys, I have known girls to do equally as well. Those coming under my observation have ranged from 12 to 20 years of age.

The primary object I always have had in view has been to encourage investigation, that they may know something of the beautiful around them and possibly make a portion of them professionals. All professionals were boys and girls once, and little encouragement did some of them receive.

I am inclined to believe that one of the reasons why so few boys and girls take to scientific investigation is because of the lack of encouragement from those who are older.

Now, the first question, "What can they accomplish with the microscope?"

That depends on the boy, his teacher (if he has any), his ability, his love for the study, his encouragement, his finances, and other things.

Among the finest slides I ever saw were those made by a boy of 16 years. Did he become a professional microscopist? No, not at all, but the spirit of investigation was aroused in him to such an extent that he graduated at Baldwin University, post-graduated at Princeton with a degree of Sc. D., and now occupies the chair of Physics in the polytecnic department of Case School of Applied Science. The world knows his experiments with the Roentgen or X-ray—Dr. D. C. Miller, A. M., Sc. D.

This is perhaps one of the brightest examples I might give, but others are doing surprising work, and are getting an insight into nature.

One lad of 13 of my acquaintance made a fine beginning with pollen mounted and dried in balsam. Another began by making sections of stems and piths of plants. The two worked together and obtained a knowledge of structural botany that probably they never would have obtained otherwise. They also examined the sap of different plants, obtaining some surprising results by evaporation. Many slides were spoiled, of course, but who is or could be perfect from the begining.

Another boy mounted spores of ferns, etc. and also made slides of wings of insects, and with such a book to study as was at his command he received a training in comparative entomology which has proven useful to him.

Making slides is but a small part of the work. I encourage laying more stress on making drawings of everything, if possible, with the aid of a camera lucida.

One fellow began by studying parasites injurious to the horticulturists. At home he was met with opposition, but when his studying led to the partial destruction of the pests and a partial crop of berries

while the neighbors had no fruit, then, and not till then, did his father praise or encourage him.

"What sort of a microscope do they use?"

That depends on the cash at hand. I always recommend if one has a certain sum for such purposes, that four-fifths of the money be set aside for the microscope, the remaining one fifth for things necessary that cannot be made,—balsam, zinc white, chloroform, etc.

If two or three can agree to put their money together and get a microscope, thereby getting a better one, they are the gainers by it in many ways.

They should also have a book of instructions. Manipulation of a Microscope, by E. Bausch, is a good one, and there are many others. In a paper of this kind I recommend no manufacturer, all having good instruments. A book for notes should be had, and as for the material, the world is full of it.

Were a person to make a boy of 12 to 18 years a present of $25.00 I would suggest that it be applied on a microscope and necessary articles that must be purchased. Some good cannot but be the result.

So, I repeat, encourage this line of study among the boys and girls that they may see more of the world about them from the commoner and coarser things to the higher and refined.

Collecting Fungi.

E. E. MASTERMAN,

NEW LONDON, OHIO.

In this locality (north-central Ohio) the year 1896 has been a very excellent one for the growth of fungi. They are to be found on the leaves, stems, and branches of plants. Taking advantage of suitable opportunities I collected as many as possible and in the same way that any botanist would accumulate his treasures. I pre-

pared them in very much the same manner. It is best to cut away the thick veins, ribs, stems, and portions of the leaves or plants that are useless or not affected. When small save all of the leaf, stem, plant, &c.

I place my specimens between very porus white blotting paper, and do not subject them to any degree of pressure for fear of injuring the fungi. I air them every day. I think this is necessary. Some leaves upon which the fungi grow need this oftener than daily.

When perfectly dry I place them in any tight envelope of proper size that fits the specimen and keep these in a tight box. When needed for study or comparison, I use the specimens as any ordinary opaque object.

Should one label them, which I think necessary, the date, locality, and collector's name should accompany the specimen. I write on my labels the name of the plant exactly as a botanist would, in fact I first label the plant botanically, then write the name of the fungus.

In collecting it is well to "git a plenty when you are a-gittin'," for you may wish duplicates to exchange. I think it well to deposit samples of each in some permanent institution, such as Experiment Stations, Universities, Colleges, &c., where they can be had for future reference and study. This course may also bring yourself before the learned to some extent and the acquantance of one or more of these people is well worth the trouble of collecting and preparing a few specimens. Corresponding acquantance is worth much to a student. Many new hints and helps may be gained while you may help some one else more than you realize.

Diphtheria is prevailing to an unusual degree in London, the mortality from the disease during the first week in October having been greater than that of any week this year.

Practical Hints for the Worker.

By B. L. RAWLINS,

NASHVILLE, TENN.

An excellent device in the way of an air pump and receiver for ridding the freshly mounted slide of air bubbles, may be made after this fashion. The pump consists of an ordinary small bicycle pump which may be made to exhaust the air from a chamber by simply changing the working direction of the valve and turning the piston leather so that the convexity comes to the outside instead of the inside of the metal disc. A washer of somewhat smaller size than the disc must also be placed in front of it to keep it from collapsing.

The receiver is made by fitting two soft rubber stoppers into a glass tube of such length that the chamber left is of sufficient length to act as a receptacle for the slide, and of such width that the slide will easily go in. For want of something better a straight lamp chimney known as the students, may be cut with a file and ground down smooth.

Through one of the stoppers a small perforation may be made and a piece of brass tubing which has had a thread cut on it to correspond with the pump nozzle, is to be tightly fitted. With a leather washer to go between, the instrument is ready for use.

While it is an advantage that a stop cock be interposed to secure the vacuum for some time it is not indispensible.

Specimens for imbedding may be put into a short test tube and put in this chamber in order to be rapidly permeated with the thin celloidin solution.

The University of the State of New York has decided that after January 1, 1897, no degrees B. A. or A. B. shall be conferred *causa honoris*.

PRACTICAL SUGGESTIONS.

BY L. A. WILSON,

CLEVELAND, OHIO.

Phyllactinia Suffulta.—This is one of the largest and and most striking of the Family Erysipheæ. The genera Phyllactinia contains but one species. The species vary exceedingly on different host plants but are considered by experts to be variations of the same species.

They are found on leaves of the magnolia tribe, on elders, beech, oak, ash and many other plants. It is in fact a very common and ubiquitous species. It is a very interesting specimen, which is easily recognized by the appendage, being swollen into knobs at the base, with the tips straight. All the manipulation required for their display is to dip them from the leaf with a spatula, transfer to a glass slip into a drop of water, cover and examine.

They show well with a one inch objective. They may be mounted and preserved in glycerine jelly.

How to Save Money.—Dealers generally charge fifty cents a bottle for immerson fluid. An amateur recently concluded to save this outlay. He procured a formula from an eminent microscopist. He purchased the materials from a reliable chemist. The formula required the boiling of the materials. The product was designed to be homogeneous fluid. The amateur boiled the stuff in a nice clean porcelain dish over an alcohol lamp. While boiling some one arrested his attention and the hot stuff tipped over, scalded his hands, spoiled his new breeches and ruined a carpet. This should not discourage any one. He may save fifty cents next time.

Hypoxylon albocinctum.—This fungus is one of the very many species of a large genus. The manipulation of one will be the "open sesame" at all. Many have seen them but have passed them by as of no importance; yet they are complicated plants well worthy of an acquaintance.

Most of them are found on leaves, bark and twigs and

form black spots from a millimeter upward in size. The black spots are the stromas, which in this species are flat, carbonaceous and purplish black. In this species the fungus grows on Crataegus. The fruit is in the upper part of the stroma. Cut a small slice, transfer to water in a glass slip and mash fine with a spatula and cover.

Examine with a one fourth or one fifth objective. This will exhibit long cylindrical asci, with brown spores arranged in a uniseriate manner. The spores generally contain a round sporo blast at each end.

Potassic Iodide for Preserving Infusoria.—The use of this medium is very simple and is said by Mr. W. S. Kent to act in a manner almost identical with osmic acid. For use, prepare a saturated solution of potassic iodide in distilled water. Saturate the solution with iodide, filter and dilute to a brown sherry color.

A very small portion, only, of the fluid is to be added to that containing the infusoria.

QUESTIONS ANSWERED.

NOTE.—*Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of all grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.*

Q. 245.—Can you tell me if there is any book published giving Microscopic examinations for adulteration of food and medicine and where it may be procured and cost? D. A. B.

A. Hassal, Food, Its Adulterations, etc., $8.75, published by Longmans, Green & Co., is the classical work; but the great bulk of more recent work is scattered through the files of the American Analyst, and the various microscopical and other technical journals.

Q. 246.—Are the fibro vascular bundles and tubes for the circulation of sap? In the sunflower there is only simple cellular tissue. How is circulation accomplished? —Snohomist.

A. Sap circulates by preference through the fibro vascular bundles of a plant, but every living cell can absorb sap and tradsfer it to contiguous cells. The sunflower stem has a ring of fibro vascular bundles in the condensed tissue beneath the cuticle.

SCIENCE-GOSSIP.

The Change Produced in Meat by Freezing.—The character of the meat consumed nowadays has become a serious hygienic matter. In a pharmaceutical journal, published in Germany, a writer describes a simple process for distinguishing between fresh meat and that which has been preserved in the frozen state, viz., the expressing of a small quantity of blood or meat juice from the sample, and its examination under the microscope. The whole operation must be performed quickly, in order to prevent any drying up of the liquid under examination. When the juice of fresh flesh is thus examined, it is seen to contain numerous red corpuscles, which are normal in color and float in clear serum. But in the case of blood from frozen flesh the corpuscles have dissolved in the serum under the influence of the lower temperature, and not a single normal red corpuscle can be seen—the hæmoglobin escapes into the serum and appears as irregular yellow-brown crystals. These may be frequently seen by the naked eye, but in every case can be readily detected under the microscope.

Death After Antitoxin Explained.—A full and satisfactory explanation of the sudden and tragic death of the little son of Dr. Langerhaus immediately following an injection of antitoxic serum, has been reached through the subsequent investigation. In the first place, the analysis of the serum proved it to be reliable, and no irregularity in the method of its administration could be discovered. It was found, however, that the child had just completed an unusually heavy meal, and as the necropsy showed, his larynx and trachea well filled with a material identical with that

found in his stomach, the accepted inference is that while faint from the shock of the injection he was unable to eject the vomited matter from his throat, and instead drew it into the air-passages with fatal effect.

It may be concluded, then, that what appeared to be quite damaging evidence against the serum was really the result of a very simple accident.—*Medical News.*

Tuberculouc Cows Destroyed.—A report has been made by Chief inspector Martin upon the sanitary condition of all cows within the city limits, and the condition of the premises where they are kept. Below the Harlem there are one hundred and sixteen different locations, in which a total of three hundred and forty-three cows are stabled. Out of one hundred and fifty-three examinations made with a tuberculin test, twenty-eight tuberculous cows were found and destroyed. The post-mortem examination confirmed the test in eveay single instance. The health of a large number of persons has been in danger from the milk supplied from these sources, and it is sincerely to be desired that the work thus entered upon may be pursued until it becomes no longer possible for so many diseased animals to exist at any time, either within the city's limits or in herds from which the city's milk supply is drawn.

English Ice Cream.—Certain confectioners and restaurateurs have a way of advertising their ice cream of extra richness as Philadelphia or New York ice cream, and charging the credulous with an extra price for the same. But for real denseness of richness the ice-cream of our sister cities is not likely to reaeh the standard of real London ices.

Dr. MacFayden and Mr. Collyer have recently completed for the British Institute of Preventive Medicine an investigvtion into the nature and quality of the creams vended on the streets of Eondon. "They report," says the Medical Record, "that ice cream has only 26.5 per cent of solids, the rest being water; that the solids consist of fats, four per cent, sugar, twelve per cent, starch, six per

cent, albuminoids, four per cent, and mineral matter, one half per cent. This all sounds well enough, and would lead the unwary reader to think that ice-cream was all right, but the denouement comes in the results of microscopical research. The microscope shows the presence, in London ice-cream at least, of bedbugs, bugs, legs, of fleas, straw, hair, coal, dust, woolen and linen fiber, tobacco, epithelial scales, and muscular tissue. Even the microscopical examination, however, is delectable compared with the results of bacteriological studies. These reveal in street-barrow ice-cream a maximum number of seven million microbes per cubic centimeter, while the shops have only one million per cubic centimeter. The character of the micro-organisms is extremely mixed. There are are the bacteria coli communis, besides spirillæ and putrefactive microbes of various kinds. We find no account of a chemical analysis, which would perhaps add the final touch to the pathological picture of the ice-cream of the shops."—*Boston Medical and Surgery Journal.*

PERSONALS.

Mr. R. E. Kerry, director of the bacteriological laboratory of the Vienna Veterinary Institute, died recently at the age of 34.

Dr. R. Meade Bolton, now bacteriologist of the Philadelphia Board of Health, has been elected instructor in bacteriology in the University of Missouri.

F. F. Jerisman, professor of hygiene in the University of Moscow, has been excluded, it is reported, from further service at the University, owing to his liberal views in political matters.

M. Francois Felix Tisserand, director of the Paris Observatory, died in Paris, October 20, at the age of fifty-one years.

CORRESPONDENCE.

Santa Barbara, California, Oct. 22, 1896.

An importer of Japanese goods occupying a store in the same building with me brings much of his goods wrapped in the grasses of the section where they are originally packed. Finding some which he assured me was from Nagoya in central Japan I made an infusion of it from which in three or four days I began to get infusorial forms which were familiar to me, amongst which some of which were of the following genera: viz: Colpidium (Schrank), Litonotus (Ehr), Oxytricha (Wzr), Paramecium (Ehr), Euplotes (Stein).

In due time other familiar genera may be found. In the absence of text-books I cannot undertake to determine species.

There are many other forms amongst which there may be some that are new, but my literature in this department of natural history is too far away to avail me here.

P. L. HATCH.

Acknowledgement.—The cuts of the scale insect pnblished in our last issue, were loaned to us by the Department of Agriculture through the kindness of Mr. L. O. Howard, the Entomologist. We regret that the acknowledgment did not accompany the publication.—*Chrysanthemum.*

Assistant Microscopist Wanted.—The United States civil service commission held an examination at the post offices in Boston, Mass., Indianapolis, Ind., and Chicago, Ill., on October 30 for the position of assistant microscopist. The salary of the position is $600 per annum, and only women above the age of twenty were admitted to the examination. The subjects of the examination were as follows: Orthography, penmanship, copying, letter writing and arithmetic. It is desirable that applicants should have a knowledge of the use of the microscope.

THE MICROSCOPE

Contents for November, 1896.

THE MICROSCOPE

DECEMBER, 1896.

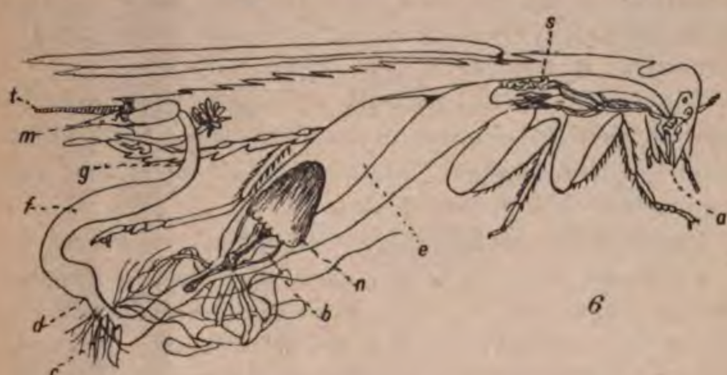
NUMBER 48 NEW SERIES

Objects Seen Under the Microscope.

BY CHRYSANTHEMUM.

XXXVI.—THE COCKROACH (*Concluded*).

Passing from the complex arrangement of jaw appendages, consider the parts of the alimentary canal. To see these, the cockroach must be dried (with blotting paper) and its under surface imbedded in paraffin. The hard and soft wings must be removed, the terga or hard dorsal



6

sclerites cut through longitudinally on each side, and removed, care being taken not to injure the heart, lying immediately beneath them in the middle line of the back. Fig. 6 will now be of great use. It shows a dissection of the male cockroach looked at from the right side.

The three well known regions—fore, mid and hind intestine are present—but the first and third differ essentially from the second as to origin. Both of them

are formed by invagination from without, and are lined with chitin. The mid intestine is the primitive alimentary canal.

The fore intestine is called the stomodæum, a mouth. It consists (1) of a buccal cavity, from the posterior wall and side of which arises (2) the lingua or tongue (fig. 6, a): a large lobe lying on the median cleft in the labium; (3) the æsophagus shown at fig. 5, t; (4) the thin-walled crop (figs. 6, e and 7, e); (5) the thick-walled gizzard or proventriculus, meaning front little stomach (figs. 6, b and 7, b). This has six articular teeth and six elevations carrying setæ, on its inner surface.

The mid-intestine or mesenteron consists only of the true digestive chylific stomach (figs. 6, c and 7, c).

The hind-intestine is called proctodæum. It consists (1) of a short or narrow intestine (figs. 6, d and 7, d) sometimes called the ileum, (2) a larger or wide intestine (figs, 6, f and 7, f) called the colon; (3) a terminal straight portion or rectum (fig. 6, g).

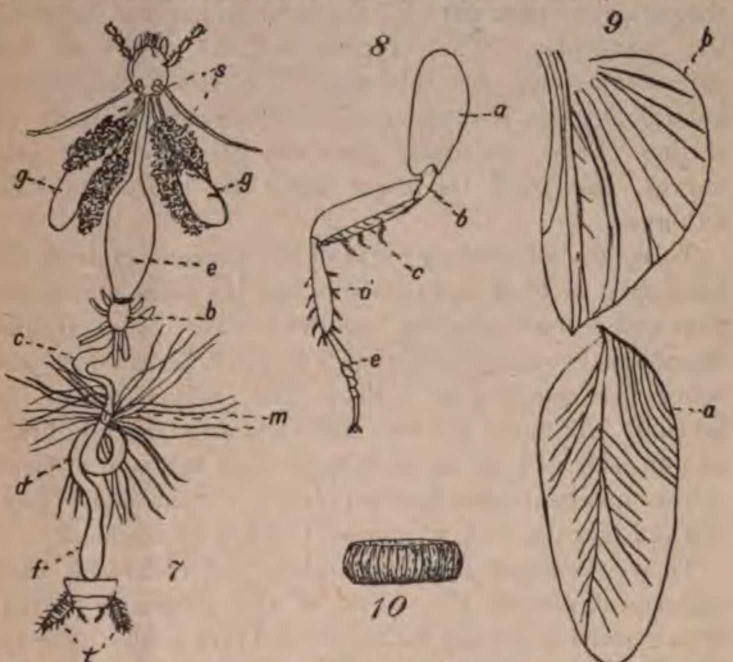
The median ventral posterior anus (fig. 7, m) is to be seen by raising the terga of the tenth or last abdominal somite with a forceps. Right and left of it are two small plates, the podical plates.

Fig. 6 shows the median, dorsal, chambered heart.

There are ten pairs of stigmata, spiracles, or breathing openings:—No. 1, at the bases of the first legs or between the prothorax and the mesothorax; No. 2, at the bases of the second legs or between the mesothorax and the metathorax; No. 3–10 between the terga and sterna of the first eight abdominal somites. The two thoracic and first abdominal stigmata can be seen by raising the wings. The other abdominal stigmata can be seen on looking at the ventral surface of the animal and stretching it slightly. Each stigma is at the apex of a little projection pointing backwards. The tracheæ, in structure, distribution, and functions are like those of the

honey-bee. Fig. 5, a, represents transverse sections of some of the head and neck trachæ.

The salivary gland (figs. 6, s and 7, s) is two lobed and branched. Fig. 7, represents the alimentary canal with its appendages of the cockroach, and is copied from Vol. V of the Cambridge Natural History. The glands are placed right and left of the crop (figs. 6 and 7). Their



ducts coming from each lobe on either side, join on each side and then those of the two sides join in the median line and open into the common duct of the salivary receptacles (fig. 9, g). Of these receptacles there are two and their ducts join in the median line and open into the buccal cavity.

The hepatic glands are eight cæca or blind tubes (figs. 6 and 7) attached to the alimentary canal hard by the junction of the gizzard (fig. 7, b) and the stomach (fig. 7, e).

The malpighian (kidney) glands (fig. 7, m) sixty or more in number are attached to the alimentary canal, hard by the junction of the stomach (fig. 7, c) and short intestine (fig. 7, d). The malpighian glands run through the fat body which surrounds the hind intestine.

To study the nervous system practically another specimen should be taken. It should be fixed by pins passed through the upper part of the epicranium, and between the mandibles. The clypeus and the front of the epicranium must be removed. The super-œsophageal ganglia or brain is supported by an internal skeleton of chitin. From its upper part are given off the optic nerves, and from its lower part, the nerves to the antennæ.

To see the succeeding parts of the nervous system, the head must be fixed upon its side and the genæ, mandibles first and second maxillæ removed. Then the circum-œsophageal commisure is shown in fig, 5 as two dots just below the œsophagus. From this, nerves go to the labrum. As usual, the two cords running from the brain one on each side of the œsophagus, end below in a large sub-œsophageal mass that supplies the mandibles, maxillæ and labrum, and, of course, belongs to the head.

To see the succeeding parts, place the cockroach back uppermost, remove the whole of the alimentary canal from gizzard to rectum inclusive, and turn aside the crop. The thoracic and abdominal chain of ganglia is thus exposed. The thoracic are three pairs, and supply the limbs. The abdominal are six pairs, connected by double cords, and supply the abdominal organs and the integument. The sixth represents the nervous centers of the sixth to tenth somites of the abdomen.

The visceral or sympathetic system is represented by a nerve given off from the circum-œsophageal commissure, and supplying the labrum and a frontal ganglion. From this frontal ganglion a recurrent nerve passes over the

outer surface of the œsophagus to a ganglion lying in the crop and giving off two branches.

The sense organs are the maxillary palpi, the labial palpi, the antennæ, and perhaps the oval cerci. The antennæ consist of three basal joints and 92 others.

The pale membranous patches or fenatræ, (fig. 4, c) near the eyes and the bases of the antennæ, are regarded as remnants of the simple eyes or ocelli. The true eyes (fig. 4, b) are large, black, reniform, compound, with many hexagonal facets and were described in the article on the honey-bee (Nov. 1895). It is probable that each of those long ocelli or cones enables the insect to see the particular part of the object commanded by that particular cone, and the vision of the insect is peicemeal, or what is known as mosaic vision.

The cockroaches run or get about at great speed. Their legs adapted for running, are three pairs, attached respectively to the pro-meso-meta-thorax. The legs are much alike. The joints, reckoning from the body out, are the coxa (fig. 8, a);trochanter, (fig. 8, b), ferma (fig. 8, c), tibia (fig. 8, d), tarsus (fig. 8, e). The coxa are large and cover the three thoracic sterna and the base of the abdomen. On the ferma and tibia are spines. The tarsus has five joints, the fifth of which ends in two claws. The male cockroach has two styles on the hind margin of the ventral aspect of the ninth abdominal somite. Also, he has the anal cerci, which are attached to the edge of the side of the tenth abdominal somite, and have many joints.

The two pairs of wings are attached to the meso-metathorax. The front meso-thoracic pair (fig. 9, a) are small and hard and called elytras or tegmina. They arise from the front corners of the terga of the meso-thorax, are made up of cuticle and skin. The wings (fig. 9, b) arise from the anterior corners of the terga of the meso-thorax and meta thorax, are membranous, and traversed by trachæ.

Cockroaches are unisexual. The male and female differ slightly. The male has two styles (figs. 6 and 7, t) attached to the ventral hind margin of the ninth abdominal somite. The female appendages are boat-shaped and are attached to the seventh somite.

The female develops egg capsules each of which carries sixteen eggs (fig. 10). These oblong capsules are carried by the mother and ultimately layed by her. The young then emerge and are helped out of the egg and of the capsules by the mother.

The cockroach and its allies do not undergo that metamorphosis which is generally characteristic of insects. The larva or young only differ from the adult by being paler in color and having no wings. It undergoes from five to seven sheddings of the skin. At last ecdysis or skin shedding of the wings appears.

The facts contained in this article are from Edward Aveling's article in the English Mechanic.

The Preparation of Diphtheria Antitoxic Serum.

BY H. K. MULFORD.

The discovery of diphtheria antitoxin was made by Behring, as a result of his primary and original investigation in connection with Kitasato upon tetanus antitoxin.

The method of preparation first proposed was the injection into suitable animals of cultures of the diptheria bacillus in which the bacilli had been killed by heat. When the animal could stand these and manifest only a slight irritation or oedena at the point of injection or by showing only feeble temperature reaction, highly attenuated living cultures were introduced in increasing amounts, a sufficient immunization or resistance being given by the primary injection to prevent fatal termination. The injection of living cultures, however, are

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* Read at Montreal before the A. Ph. A.

greatly to be discouraged, since such injections, and those of attenuated cultures containing dead bacilli, and accompanied by great destruction of the cellular tissues of the animal which is to furnish the antitoxin, its physical strength being greatly lessened by such destructive processes.

The method is as follows: As virulent a culture of the bacillus diphtheriae is obtained as possible, it is grown upon Loeffler's solidified blood mixture consisting of :—

Blood serum..................................	3 parts
1 per cent glucose boullion.........	1 part

and placed in an incubator at a temperature of 45 degrees centigrade.

After a period of 24 hours the cultures are developed. From this a single colony of the bacilli is transferred into small flasks of a two per cent peptone boullion, rendered decidedly alkaline to litmus. These small flasks are placed in an incubator, which is kept in a constant temperature of 37 degrees C. for 24 to 48 hours, and afterwards the contents are transferred with a pipette into rounded flat flasks, of a capacity of 500 cc. These large flasks are placed in an incubator, and kept at a constant temperature of 37 degrees C. until the bacilli have become very numerous, and have secreted enormous amount of active and powerful toxin in the boullion.

When this has taken place a microscopic examination is made, to see that no foreign bacilli are present and the diphtheria toxin contaminated. If uncomtaminated, 1 per cent trikresol is added to prevent contamination, and to destroy the bacillus diptheria. The boullion, or as we now term it, diptheria toxin, is filtered through a modified Chamberland filter, to separate it from the dead bodies of the diptheria bacilli. No bacilli are therefore injected into the animals to be immunized, and they are not given "diptheria" but the toxin secreted by the bacilli.

The toxicity of the toxin is determined by its injection into guinea pigs, and to be of a desired strength, 0.01-0.1 cc. should produce death of the control animal in from 24 to 36 hours.

For the preparation of diptheria antitoxin any animal may be selected, but horses are preferred, inasmuch as they are more easily operated upon, and because they furnish excellent serum in liberal quantities. Our experience, as to the type of horse selected, particularly in the earlier observations has been valuable, being of unusally good quality, a number showing trace of fine breeding; such horses however, are not suited for immunization, the finely bred horse being sensitive, frets at his inactivity (for no work is performed by the animal while being immunized, only a sufficient amount of exercise being given to maintain good health) neither does he take kindly to the injection of the toxin, or the subsequent bleeding operations. The preference is given to large, compactly built animals of dark color, 16 to 18 hands high, from 1400 to 1600 pounds weight, of quiet disposition and in good health.

Before injecting with toxin, the mallein test for glanders, and the tuberculin test for tuberculosis is applied, the results of such being clearly shown in the temperature, which is carefully recorded. Animals responding to either of these tests must be discarded.

The primary injection of the toxin is 1 cc. and in equal periods of from six to eight days, constantly increasing amounts of the toxin are administered until in about ten weeks to three months, as great quantities as 300 cc. of this powerful toxin may be borne with tolerance. When the injection of these larger amounts is accompanied with but little elevation of temperature, and but a slight oedema is manifested at site of injection, a trial bleeding of 20 cc. of blood is made, the blood always being taken from the jugular vein. If the tests for antitoxic value,

as described later under the testing of antitoxin, are favorable, the horse is bled a large quantity, the blood being collected in sterile bottles, and placed in a refrigerating room for a sufficient time (about 24 hours) until the coagulation allows the clear serum, which contains the antitoxin, to separate. This serum is drawn off by pipettes and preserved by the addition of 0.5 per cent trikresol.

The most important step now awaits the operator, the determination of the exact strength possessed by the antitoxin, as expressed in immunizing units.

For this purpose the minimum fatal dose of a strong toxin is accurately determined by the injection of various amounts into a number of guinea pigs; the smallest amount of toxin that invariably causes death of the animal in a reasonable time being regarded as the minimum fatal dose. It is usually calculated, so much per 100 grams body weight.

A page from the laboratory record shows this determination of strength, having found the minimum fatal dose of the toxin used to be .005 per 100 gram guinea pig, the control animals are given ten times this absolutely fatal dose of diphtheria toxin, per 100 grams weight and if testing for 100 units per ccm. as appears from experiment on control animal 1080, 1-1000 ccm. antitoxin obtained from horse 109 H is given. If testing for 250 units per ccm. 1-2500 ccm. of antitoxin would be given; if for 500 units 1-5000 ccm. of antitoxin would be administered.

Tests for 500 units are shown on control animal 1070, for 350 units on control animal 1076.

While this paper does not deal with the therapeutic value of diphtheria antitoxin, the absolute scientific value and correctness of these tests may be appreciated by the observations, and we prove the application of the antitoxin by its neutralizing or protective value upon the animals receiving ten times the absolutely fatal amount of

oxin. Unfortunately we cannot arrive at the exact dose for therapeutic application by this method, since the human subject is much more susceptible to the poison than the guinea pig, and we have no possible means of determining the amount of toxin secreted by the diphtheria bacilli in the patient suffering with diphtheria; therefore if any error in amount of antitoxin administered is made, it should be its administration in excessive rather rather than in an insufficient quantity.

Appreciating however, that the effect of diphtheria antitoxin is only in neutralizing the toxin of diphtheria, we know how necessary it is to make application of this "healing serum" before the nerve centres become paralyzed; the heart and kidneys become diseased and the entire system invaded by the absorption of the fatal toxin.

Diphtheria antitoxin is a most delicate substance, and its preparation can only be safely carried on in thoroughly equipped institutions, where men of undoubted integrity and ability are in supervision.

While antitoxin is a delicate substance, yet, when a proper preservative in a sufficient amount is used, and it is hermetically sealed in sterile vials, it will preserve its strength and antitoxic value for at least six months; indeed repeated experiments prove that its retains its activity for a much longer period.

Antitoxin is usually supplied in bottles containing varying quantities of serum, but of a certain number of immunizing units. This is apt to lead to confusion, and we would strongly recommend that a fixed standard of a definite number of immunizing units be secured in each cc. of serum. While this involves extra labor, it prevents confusion on the part of the physician, and the end is well worthy of the increased labor. If serum is produced of a strength of 125 units per cc. the result is that each cc. will contain 100 immunizing units, and if it is de-

sired that 600 units are to be administered. 5 cc. will be understood as the amount to be injected, etc.

It is a matter of gratifying interest to Americans, that serums of the highest antitoxic values have been prepared in our own country. Serums are now produced in which each cc. contains as much as 800 units, and we confidently believe as great an amount of antitoxic units as 1000 to the cc. will be produced in the near future. This overcomes the chief objection that has been urged against the serum, even by its warmest advocates—more prompt absorption will take place, ensuring quicker results, besides the attendant dread caused by the large instruments necessary for the introduction of large amounts of weaker serums will be avoided: 2000 units may thus be administered in an ordinary hypodermatic syringe.

Dried serums are much less active than fluid or fresh ones. They are prepared by the addition of aluminium or ammonium sulphate, with subsequent precipitations of the antitoxin by a one per cent soda solution, or by inspissation. They have given fairly good results, but cause greater irritation than do fluid serums, and not being freely soluble cause anoyance in administration, and give greater opportunities for contamination in their preparation and in the dilution for administration.

The accepted theory of the action of antitoxin, is that it renders the living cells of the organism tolerant to the toxin liberated by the diphtheria bacilli, and by increasing this tolerance they are able to overcome these toxins.

That antitoxin exerts no chemic action on the toxin can be proved by mixing toxics and antitoxins maintaining the mixture at a temperature of 70 C. At this temperature the antitoxin is destroyed, while the toxin remains but slightly disturbed in virulence.—Registered Pharmacist.

The Academy of Medicine, Paris, France, offers a prize of $160,000 to him who will discover a specific for phtisis.

PRACTICAL SUGGESTIONS.

BY L. A. WILLSON,

CLEVELAND, OHIO.

How to Manipulate Lichens.—Many amateurs look at a few stock slides and then tire of the microscope. However, the field for investigation is boundless and so extensive that no individual scientist can become great or thorough in more than one field. Lichens have been explored by many pioneers but they are still upon the confines of science and have been investigated by the few-and far-between. This neglect is largely owing to the fact that some of the most prominent authors on the microscope dismiss lichens with the statement that no one but the advanced manipulator can deal with them. This idea is entirely erroneous. The merest tyro can easily manipulate them satisfactorily and demonstrate their hidden structure.

By macerating the thallus or the apothecia while soaked in a drop of potassium hydrate on a glass slip, covering and filling the cover with water, the whole structure may be displayed and examined.

Then the spores may be easily measured and the reactions of different specimens with iodine may be observed. Many species have remarkable and beautiful spores.

To Him That Hath It Shall Be Given.—In studying any subject or branch of science it is much easier to learn the properties of a single specimen by having a large collection of various specimens of the things under examination. This applies to hair, plants, textile fabrics, blood, food adulteration aud in fact almost universally. It is impossible to compare objects and see their resemblances or differences unless you have the objects to set in juxtaposition.

No Excess of Balsam is Necessary.—In mounting, the observance of a little care, will obviate the necessity of any surplus of balsam. A little practice will effect the desired end. Place the balsam in the center of the slide

and cover. Then heat until the fluid flows and fills the space under the cover. Use a little less balsam than seems necessary. A little pressure on the cover will spread the balsam to the edge.

How to Obtain Paste Eels.—Paste eels are undoubtedly fattened vinegar eels. These objects are always interesting to exhibit to friends. It is not as easy to procure them from the limpid vinegar as from the thicker paste. In the vinegar they are too active and dart too rapidily from the field; in the paste they become fat, large and sluggish and remain in the field. For their production, make some boiled flour paste; add to this a few drops of cider vinegar and in a few days the paste will teem with the eels. Be sure that the added vinegar contains eels; to do this, hold the vinegar cruet between yourself and a strong light and examine with a pocket lens. In the drops of vinegar added to the paste, secure as many eels as possible. Keep the supply in an uncorked, open-mouthed bottle with as broad a base as possible.

SCIENCE-GOSSIP.

How Roquefort Cheese is Made.—It is supposed that hundreds of years ago the South of France was disturbed by volcanic eruptions, which slit up the ancient granite rock causing streams of lava to flow from them. The new surface consists of basaltic rock, which in its turn was fissured by eruptions and thrown up on a mountain range. The whole of the interior of a mountain was thus formed into caverns and caves, which belch forth hot sulphurous springs. It is here that the celebrated Roquefort cheeses are made. The village of Roquefort is situated on the Mountain Larzac, which is about twenty-five miles in length and nearly 3,000 ft high. It consists chiefly of limestone, covered with sufficient pasture to feed the 300,000 sheep kept for their milk. The caves, being formed by the displacement of rocks, consist of an intricate laby-

rinth of open spaces and passages connected with each other and with a subterranean outlet. A cool current of air, therefore, always of the same humidity and temperature, flows in a never-interrupted stream through the caves. There is nothing in the milk or in the preparation of the cheeses that give them that peculiar flavor and delicious mellowness for which they are so renowned. This is entirely effected by the method by which they are cured. When the cheeses are ready for treatment they are taken to the caves, and after being allowed to cool are carried to the salting room. They are rubbed with salt on one face and then piled on the top of each other until the cave is full. After standing twenty-four hours or so, the reversed side is salted, and once more they are piled up as before. The cheeses have to be frequently reversed, in order that the moisture may be even throughout, and to develop the fungus which has previously been sown in the curd. In forty-eight hours the cheeses become viscous, and are rubbed with a coarse cloth. In the course of another two days the fungus will appear on the outside, in the form of a sticky paste. This is carefully scraped off with knives, together with a thin stratum of crust, and set aside for food. The cheeses are now sorted out; the most solid ones placed on the floor. In eight days' time they become covered with a yellowish red mould, together with other minute vegetation, which is removed and given to the pigs. The scraping is continued until the character of the mould changes, showing that the curd has altered its condition, and announcing its completion of the cure. Then they are again carefully scraped and wiped, and wrapped in tin foil, and are ready for the market. Roquefort cheeses have been cured for centuries by this process, and stand as a triumph of uneducated art.—Commercial Gazette.

A Giant Lens.—The largest telescopic lens in the world is now completed. It is the great refractor made by Alvan Clark of Cambridge for the Chicago University; and it will be used at the University's new observatory, now in process of completion at Lake Geneva, on the Wisconsin side

of the northern border of Illinois and about seventy-five miles northwest of Chicago. The air there is free from Chicago's smoke.

The object-glass is within a fraction of 42 inches in diameter—being exactly 41⅜ inches. The great objective of the Lick observatory—the next largest one—was made by Alvan Clark, the father of the present telescope-maker, and is 36 inches in diameter. The tube, or focal distance, in the Lick telescope is 57 feet. This new and still bigger glass is to have a tube 61 feet long. It is now being finished by Warner & Swasey, at Cleveland, Ohio, who will mount the instrument equatorially, and who have already made the ring for the objective. In this great refracting glass the sheet of crown glass is 3 inches thick at the middle, 1¼ inches thick at edges, and weighs 205 pounds; while the flint glass weighs 301 pounds making 506 pounds for the objective irrespective of the ring. The whole will weigh about 1,000 pounds, and it may be a problem to keep the big glass from bending, after all.

The cost of this giant lens is over $100,000. Its raw material (which cost $40,000 in Paris) was repeatedly melted by Mr. Clark, for the sake of purity and perfection. It has taken two and a half years to make this big object-glass.

The elaborate work of packing this precious product, for transportation to Lake Geneva, Wis., will be careful and costly. First it will be tightly wrapped and sewed up in flannel; then thickly covered with layers of soft paper; then wrapped in hard paper, and the whole encased in a bed of curled hair in a strong box. This, placed within a larger box and mounted upon springs, on all sides of the inner box, and packed in excelsior, will rest in the middle of an easy going parlor car, and four men will go with the precious freight, which may be destined to reveal interesting things concerning "other worlds than ours."

Prof. Koch has been sent to South Afriea by the German government to investigate the causes of the Rinderpest.

THE MICROSCOPE

Contents for December, 1896.

THE MICROSCOPE INDEX.

COMPILED BY HANS M. WILDER, PHILADELPHIA, PA.

LIST OF ILLUSTRATIONS.

Vol. 2, No. 1. NEW SERIES. Whole No. 13.

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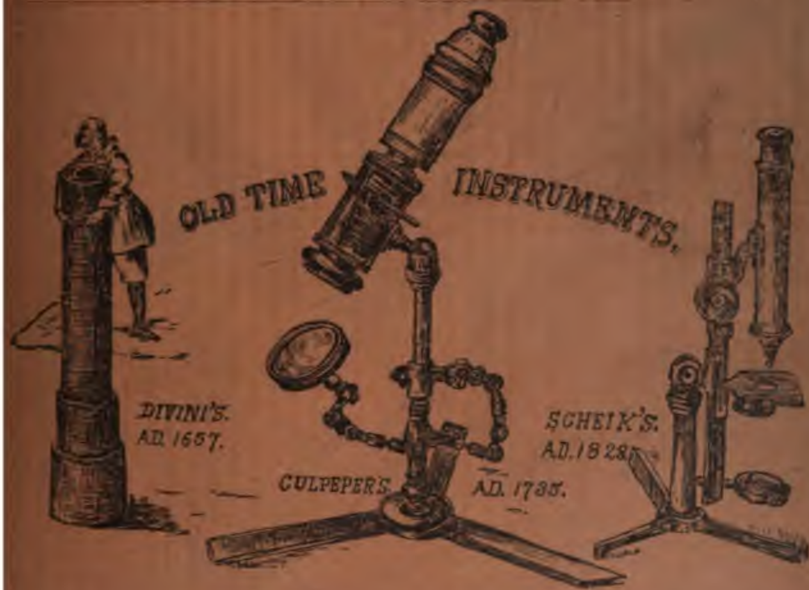

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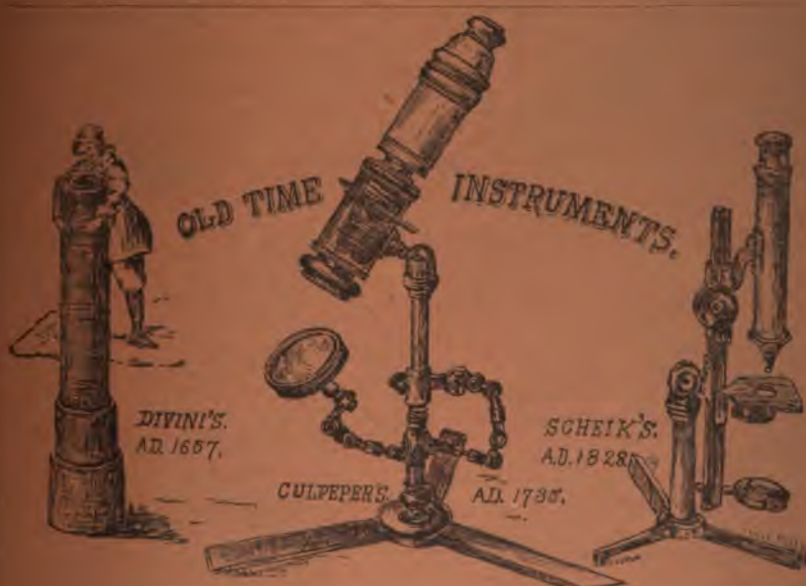

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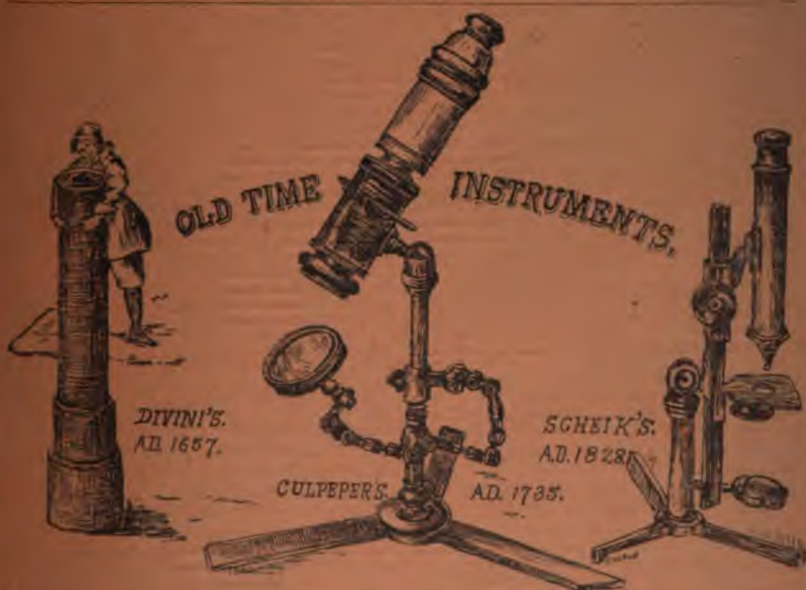

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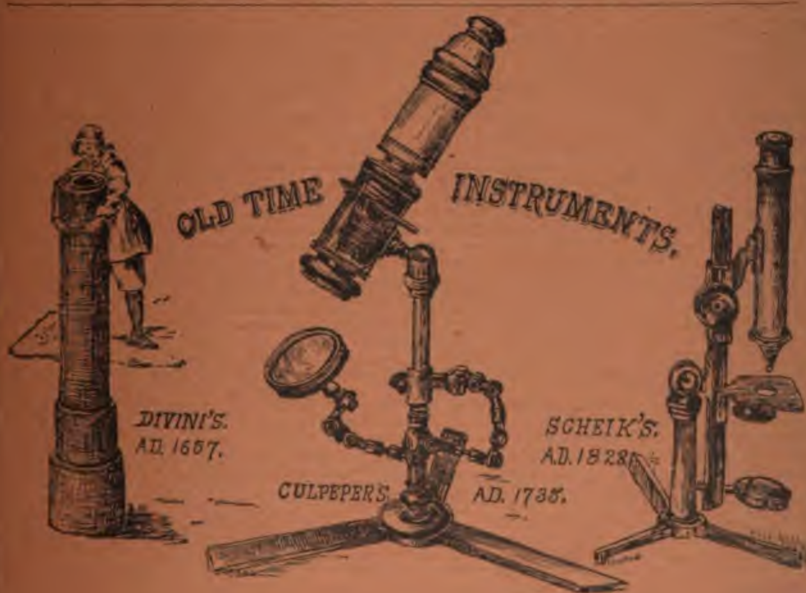

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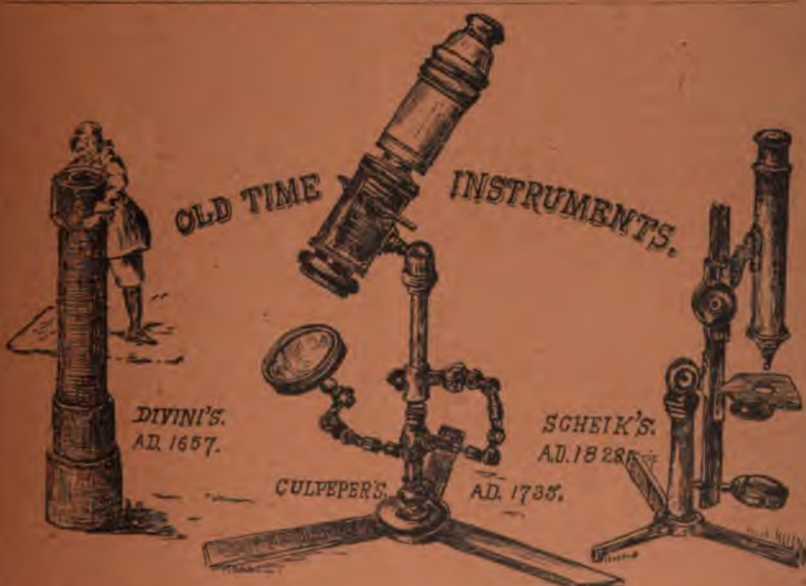

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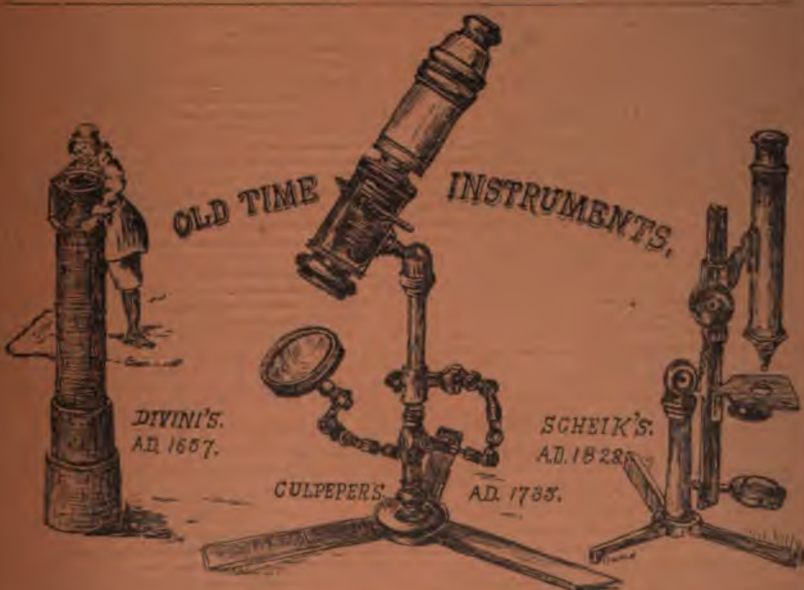

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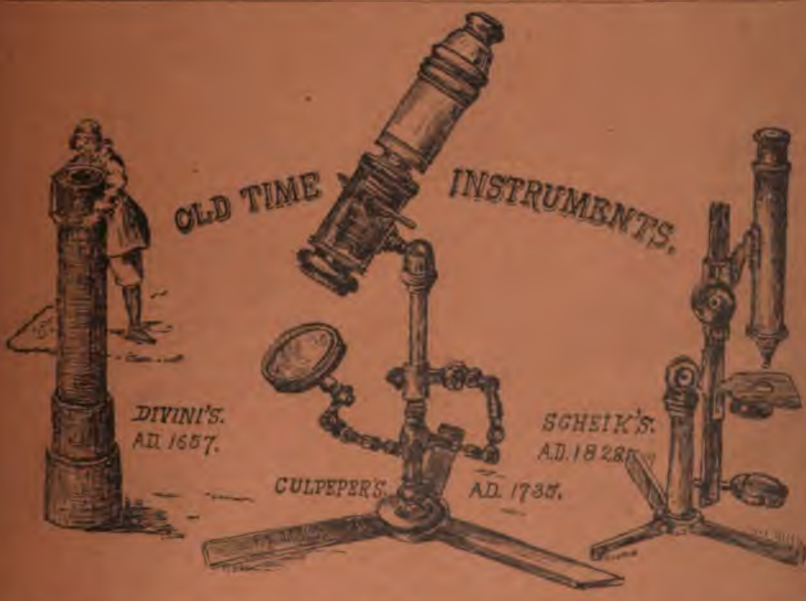

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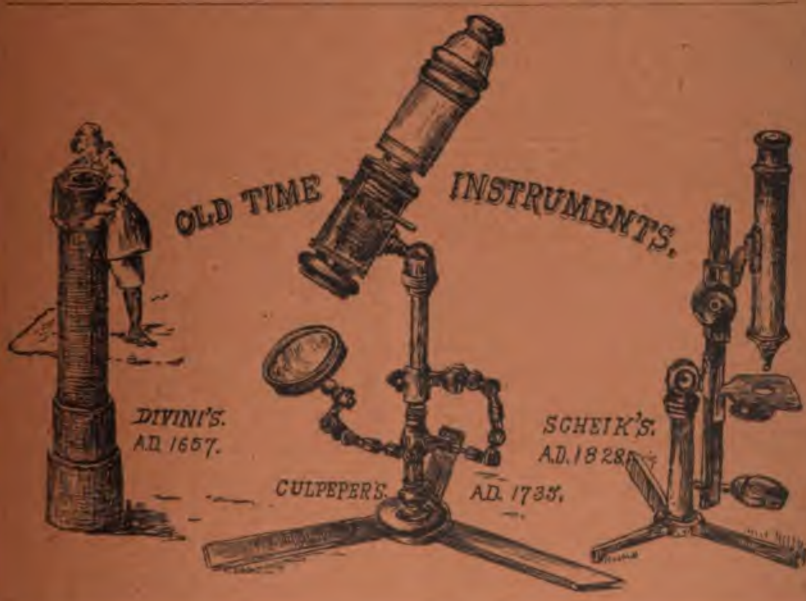

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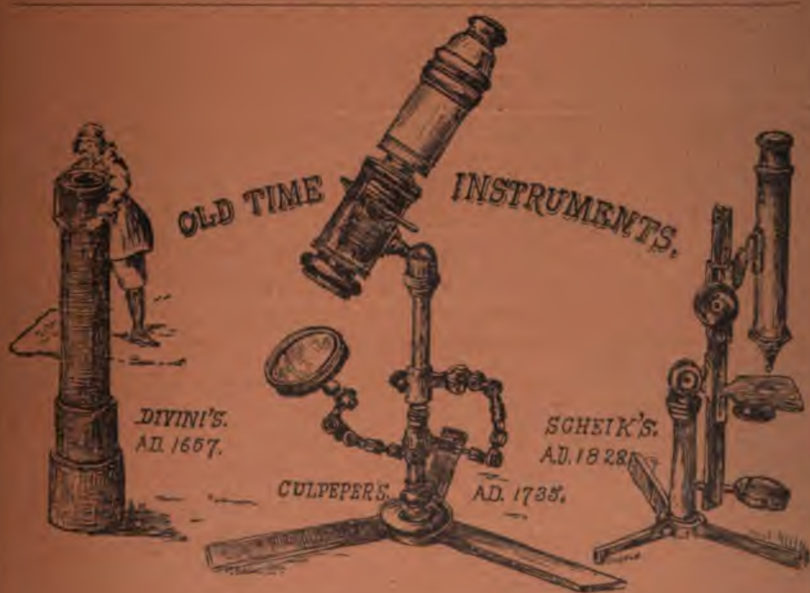

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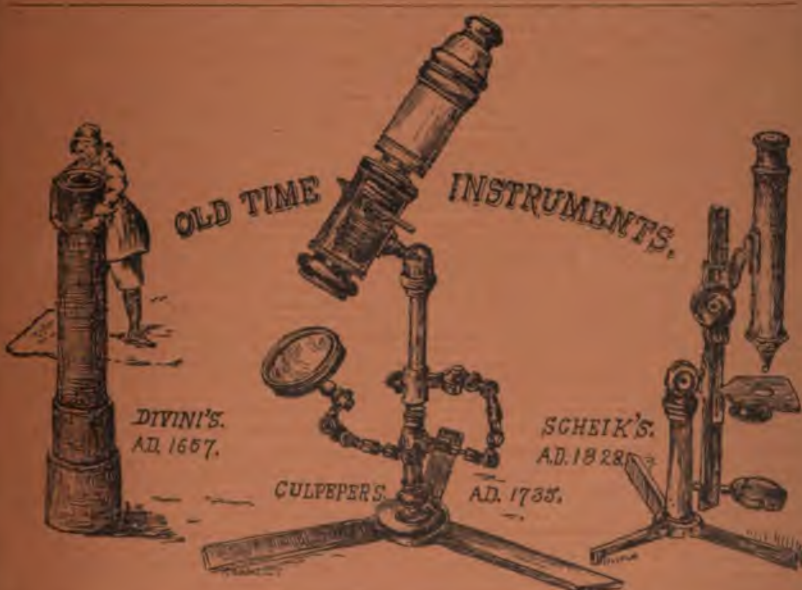

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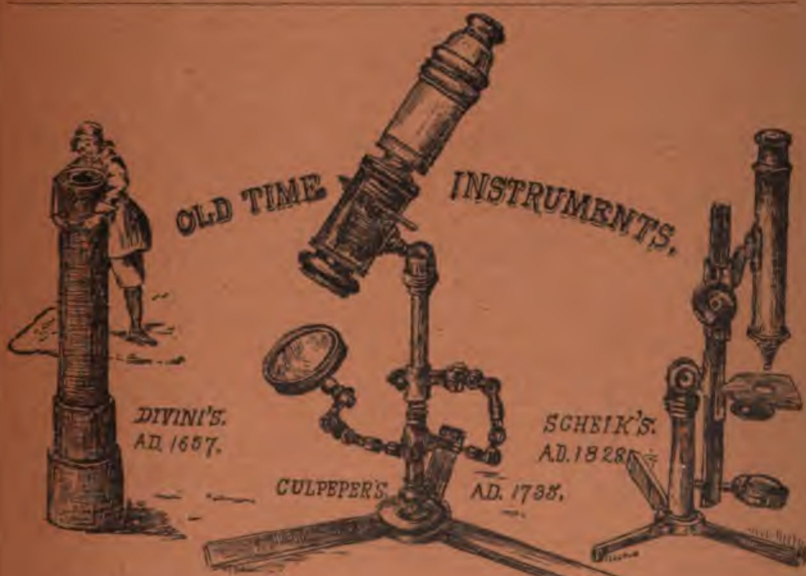

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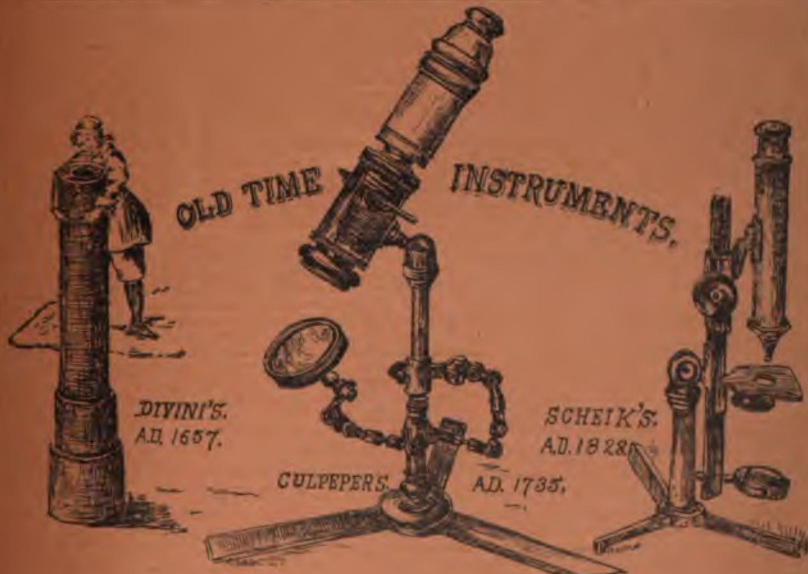

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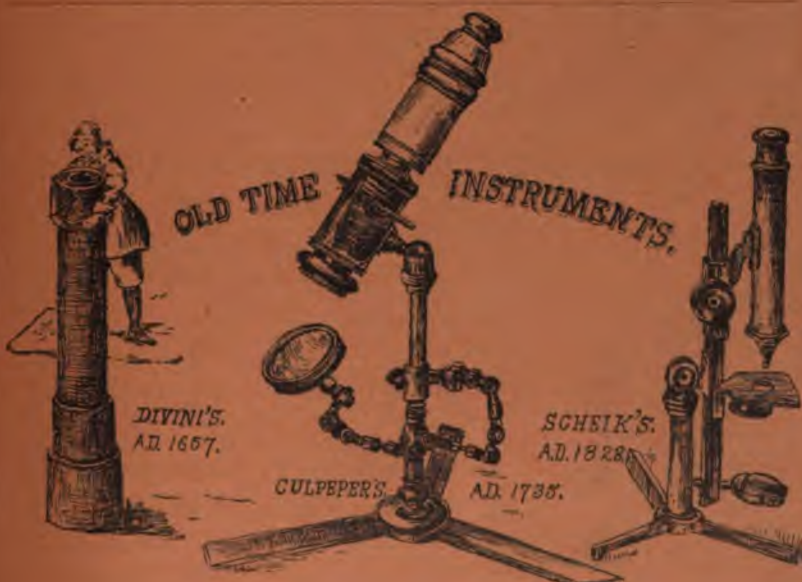

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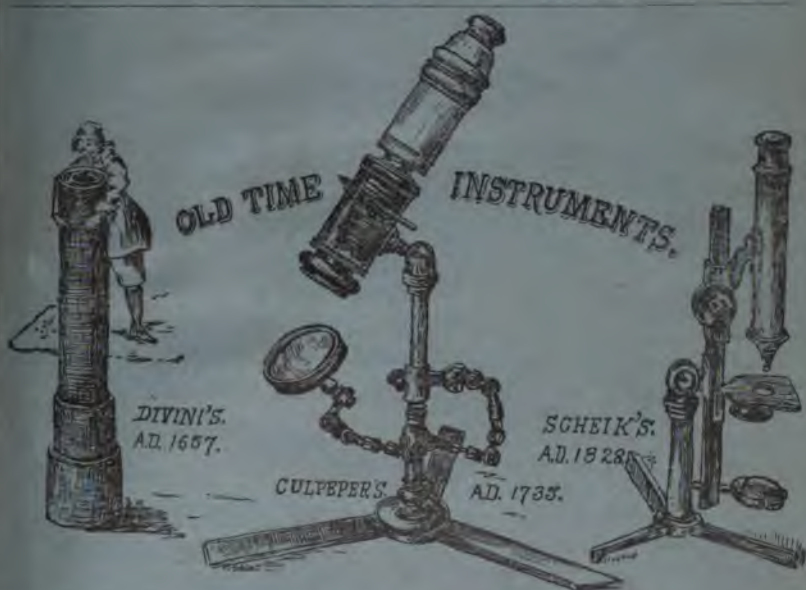

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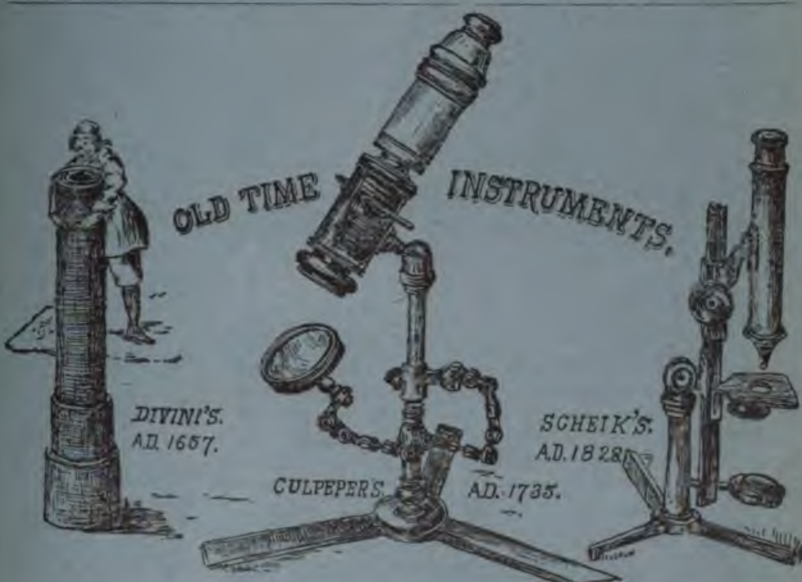

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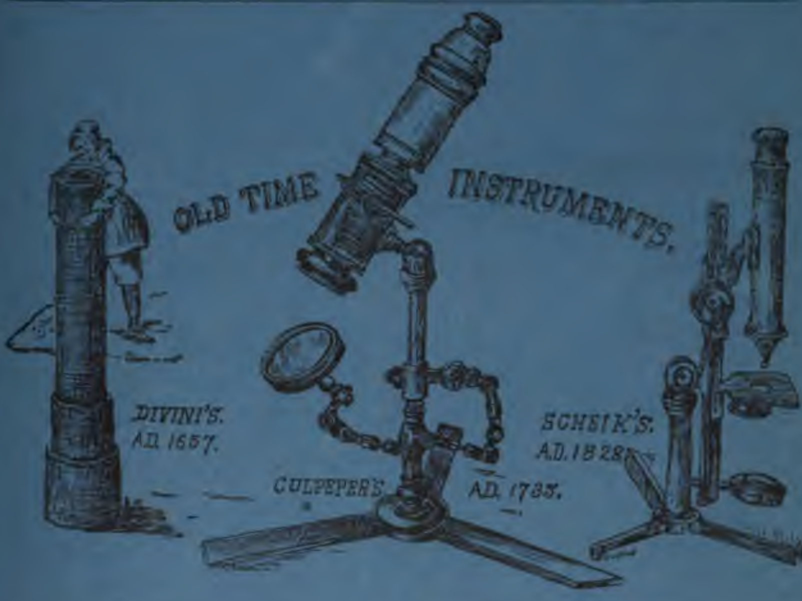

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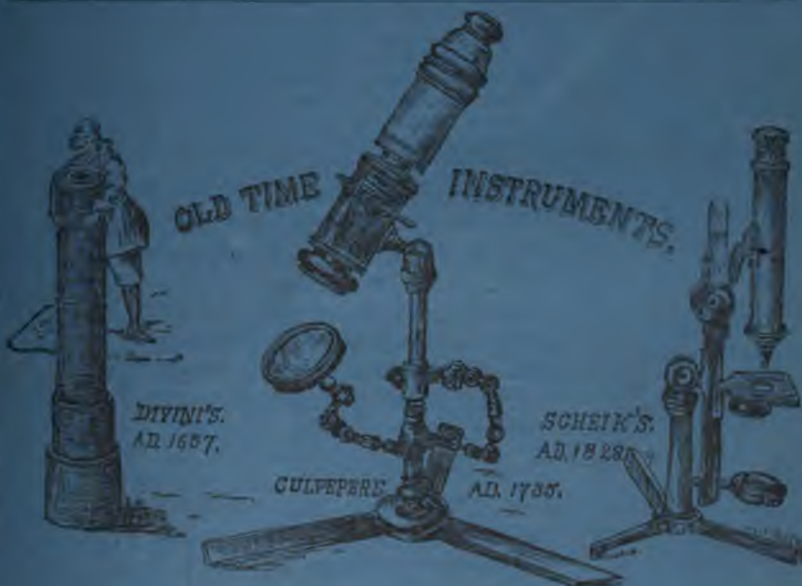

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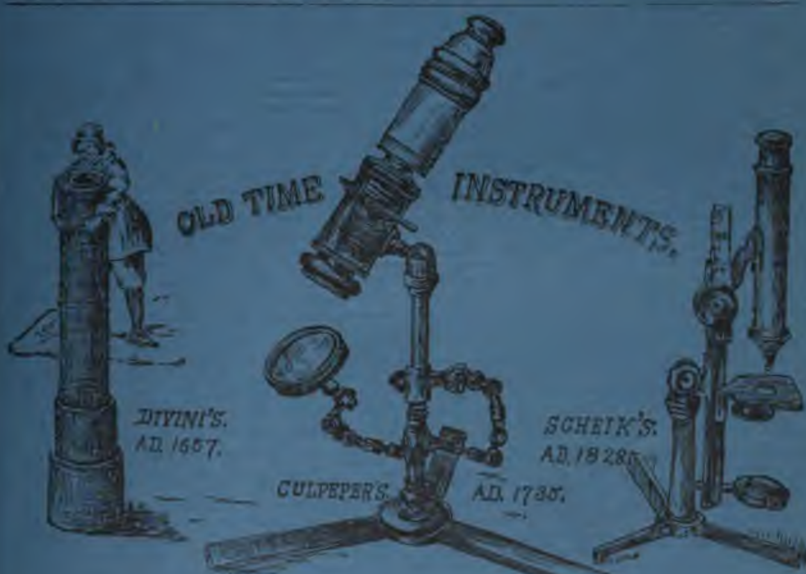

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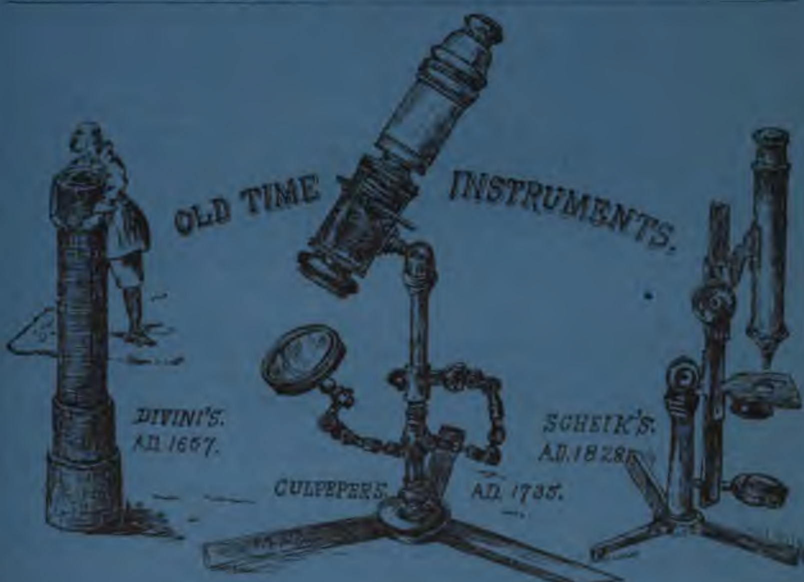

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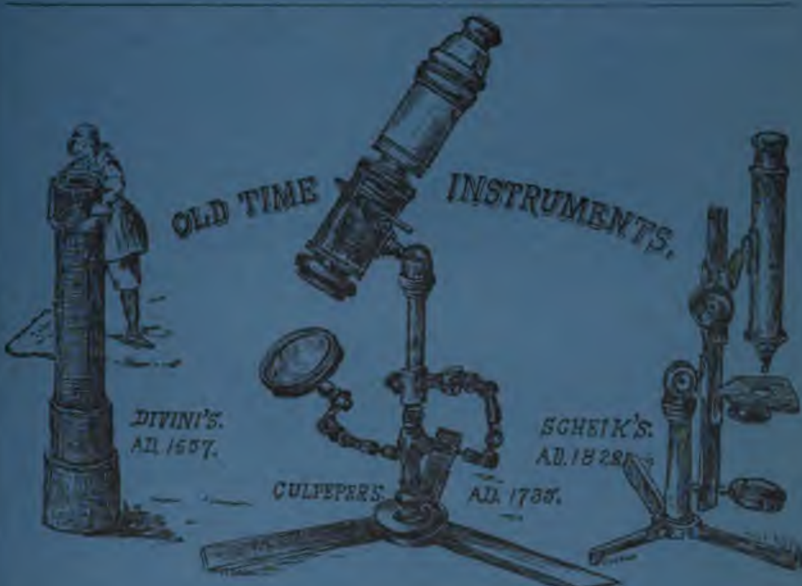

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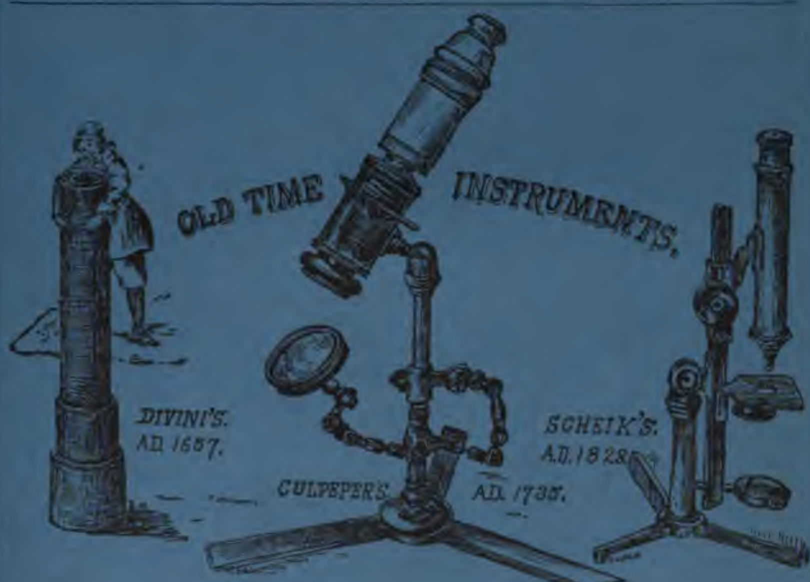

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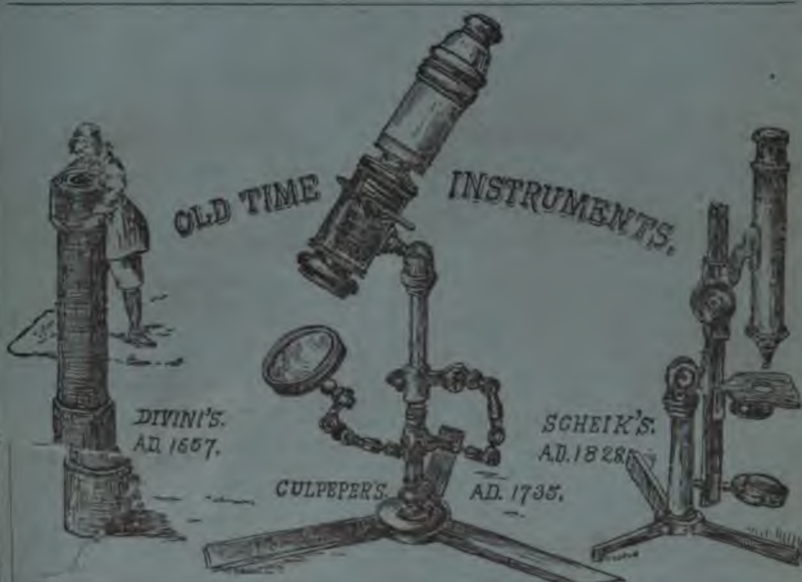

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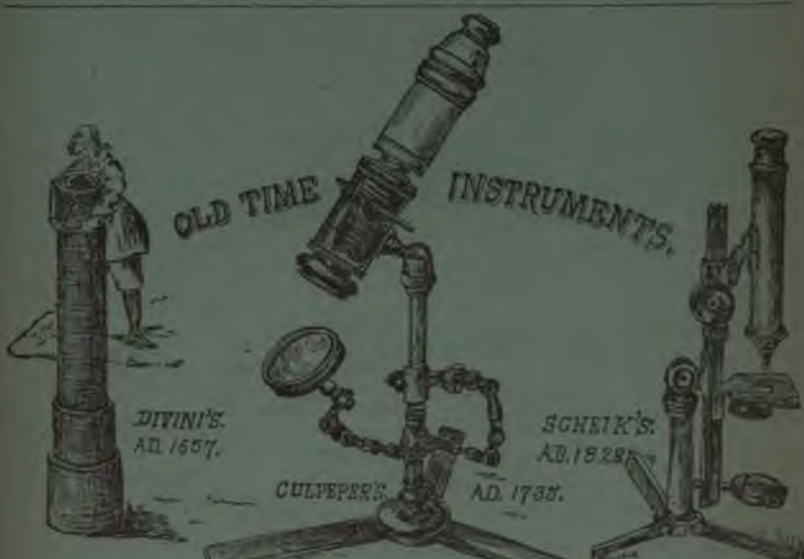

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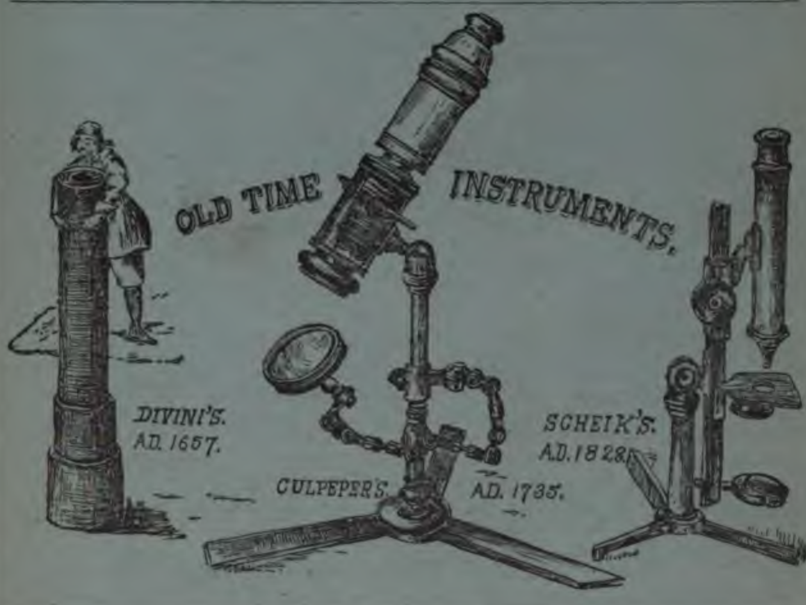

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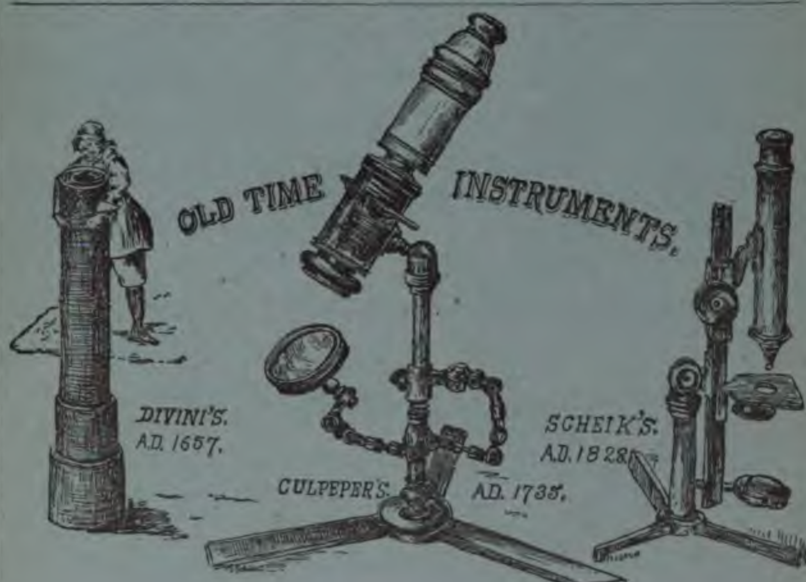

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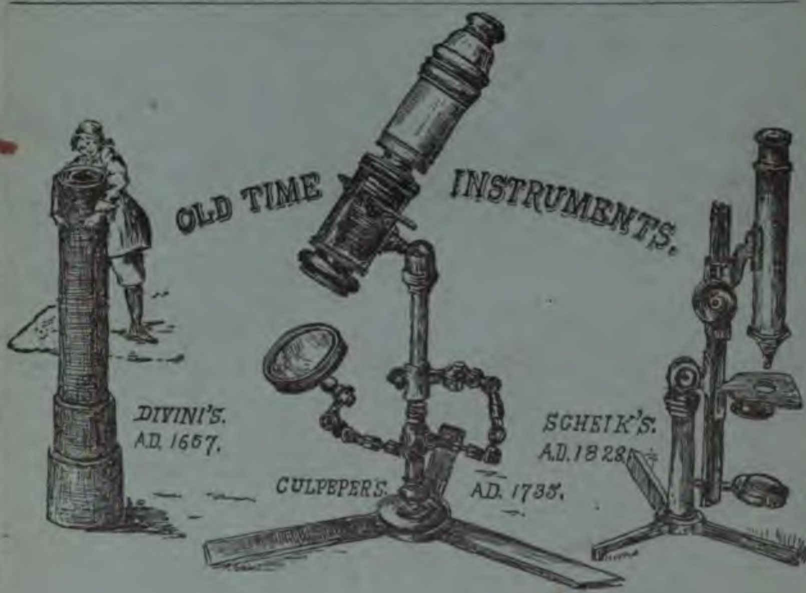

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